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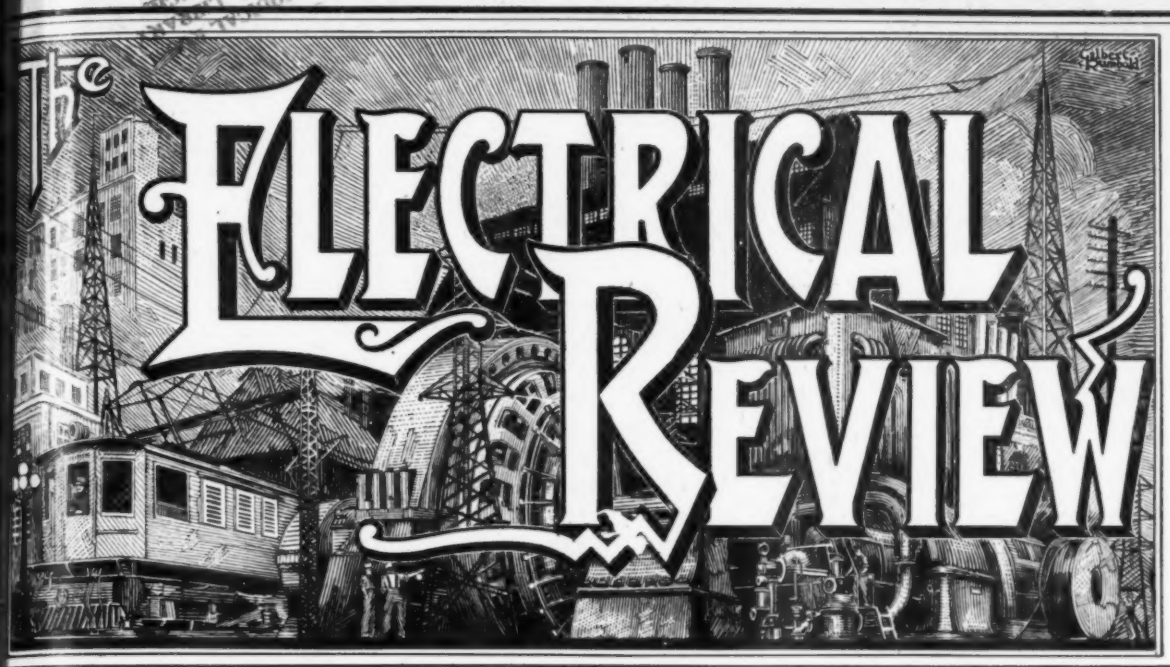

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JULY 13, 1923

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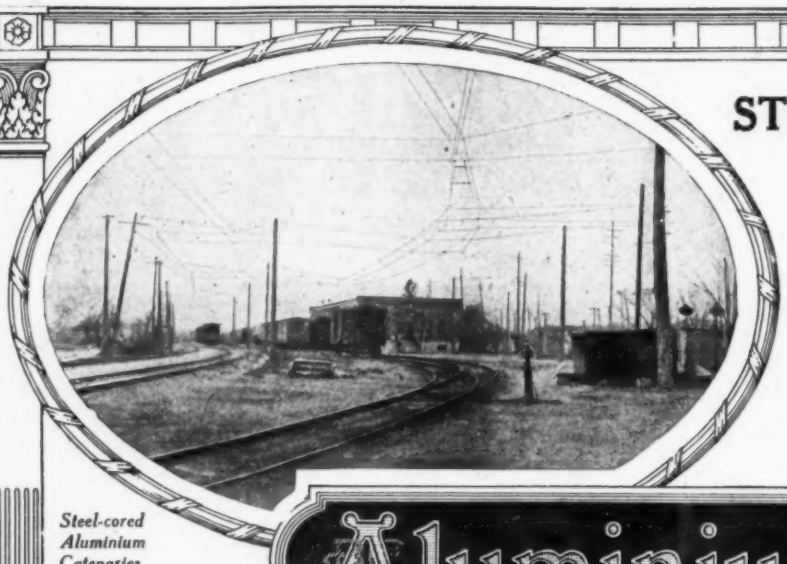

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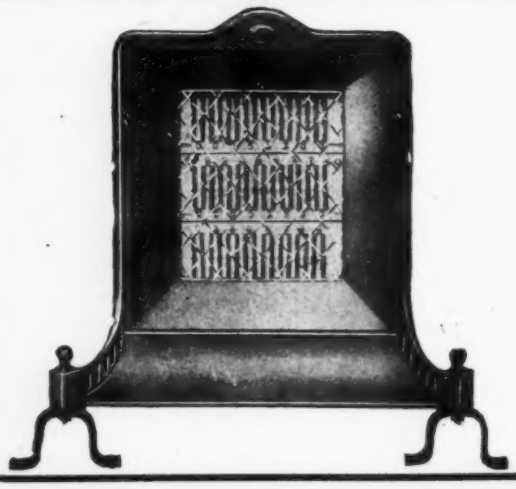

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ELECTRICAL REVIEW.

VOL. XCIII. JULY 13, 1923. No. 2,381.

ELECTRICAL REVIEW.

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THE TRADE SITUATION.

AMONG the points touched upon by Sir Eric Geddes in his Bradford F.B.I. speech was the very old question of the prevention of cyclical fluctuations of trade. In pre-war days the subject was discussed whenever there was a trade slump, but in the days of prosperity little heed was given to it. All sorts of propositions have been advanced by statesmen, industrialists, and economists, but crises do not conform to rules, and they ignore all such propositions by the untimeliness with which they occur. A home or local crisis may throw into a state of chaos some particular trade or trades, and a world crisis may affect all trades. It was so when industrial organisation was far less efficient in all countries than it is now. May we reasonably anticipate that with the more efficient organisation that has followed the course of events of the past decade, we can better guard against or provide for cyclical fluctuations? Sir Eric Geddes holds the view that the cyclical depressions and heights of trade are really the outcome of the psychology of the manufacturer and the banker, but principally that of the manufacturer. As he sees it, these fluctuations are caused by lack of accurate knowledge as to what the world can consume, and here he appears to look upon modern industrial organisation as being able to assist. While it "would be idealistic to hope that in this imperfect and competitive world we could estimate exactly what we could sell, partitioning the demands among the various producers," he feels sure that much can be done by the collection and collation of information by the great trade and industrial organisations, to enable their members to forecast more accurately what the demand will be, and what production will be.

Whatever may be contributed to the discussion of this subject at the present time may not assist matters much while we are still suffering from the great unsettlement that has followed the world upheaval of 1914-1918. The state of the foreign exchanges and the situation in Europe, in Russia, and elsewhere are all the consequences of that calamity, and until order is gradually evolved, no contribution to the study of cyclical fluctuations can be of any great value.

Sir Eric has admiration for the better way in which authorities in the United States have managed to compile knowledge of American consumption and production, and declares that their published data as to these matters, and the vital statistics that lead up to that knowledge, are far ahead of ours. Well, nobody has reason to know better than Sir Eric that there is such a thing as an "AXE," and that sometimes that tool may be destructive of good schemes as well as of cherry trees in father's garden. A zeal for economy may eat up usefulness in the collection of statistical information, and we may even have to defer the compilation of a Census of Production. In the States, which manufactures and grows so largely for itself, the subject of cyclical fluctuations should be more easy to handle than it is with peoples which depend so largely for their existence upon the development and purchasing power of other countries. We are at one with Sir Eric

when he puts the settlement of the European situation very prominently among the measures which can be taken for the improvement of trade and the reduction of unemployment here. But we wonder whether it is not a little too optimistic to say that the great problems of this country "would melt as mist melts before the sun" if a stabilised condition could be brought about in Europe? Chairmen of electrical and engineering manufacturing companies have lately emphasised the importance of the European situation—not so much because they look to Europe as a big market for their products straightaway when relief comes, but because settlement in Europe might herald general settlement in most parts of the world. If electrical and engineering development could advance unrestrained in these islands and throughout the world, they would have plenty of business to utilise their enlarged productive capacity, though there is so much scope for electrical activity that we question whether they would be able to compile statistical information regarding future world consumption. World demand when the brakes are removed will leap ahead quite unconcerned with the desires of trade organisations to measure its probable volume.

We select for comment one other point touched upon by Sir Eric, because we feel that it should receive more attention than has been given to it. He says that the future of British trade depends on improvement in factory efficiency, and again advances as a matter for our study the progress that is taking place in the United States. He recognises that there has been a tendency here to laugh at the efficiency engineer. Perhaps some of our firms have become "fed up" with the latter because of his fanciful and impossible propositions and grandmotherly ideas. They have paid his fee and allowed him to pass on to his next "victim." That attitude may in cases have been fully justified—we believe it has been so, but it would be unfortunate if we failed to avail ourselves of the benefits that may be derived from efforts to improve the efficiency of the worker and the efficiency of means of production because a few zealots have overdone their calling.

In the course of Sir Eric's study of the question of greater efficiency, he tells us that in America, since 1921, there has been an all-over improvement of 15 per cent. in the industrial efficiency of the operative. He is not clear whether that is due to the better organisation of industry and a higher standard of factory management efficiency, or whether it is "because America is dry." The disposition is to smile incredulously at America's manner of handling the liquor question, but we think that Sir Eric has done a service in mentioning this point in connection with industrial efficiency. What the people of America may decide to do in such a matter is their own concern, but the consequences of their adopted policy upon industry are a matter of world concern, and must be taken into account by serious students of industrial economics in this and other countries. Sir Eric does not enter into a detailed discussion on the question of prohibition; what he says is this: "Talking from the point of view of industrial workers, America is practically dry, and all we hear about the bootleggers and the ease with which liquor is obtained does not apply generally to the industrials in the States." This fact—and Sir Eric would hardly make such a statement before so representative and serious an organisation as the F.B.I. if he did not think it worthy of deep consideration—has to be faced along with the 15 per cent. increased efficiency on the part of the operative. Several years before the war, in trying in these pages to find out the causes of British national industrial weaknesses, we referred to the effect of drinking habits upon the output of the worker. We did so as the result of interviews with leading industrial employers, and of an examination in certain works of the obstructive effects upon productive efficiency of men who, though highly skilled and competent at their work normally, frequently gave bad work and interfered with the expedition of the operations of others, because of their habits. We have no reason for thinking that there is any great alteration in this respect to-day. We are an industrial or trade paper—not an organ of faddists, pussyfoots, or unbalanced enthusiasts who claim a right to interfere with the freedom and liberty of the individual—and it is because we are concerned with the importance of improving efficiency all round that we quote Sir Eric's reference to this question. We should like to see an absolutely impartial study by an industrial authority regarding what is happening in America. Is not the F.B.I. a suitable organisation to undertake an exhaustive, first-hand examination? After two years' experience Sir Eric Geddes suggests that American industrial efficiency is 15 per cent. better. If that be true, it is an addition to our handicap. Sooner or later there will be a verdict forthcoming.

The Electrical Pavilion.

We would urge electricity supply authorities not to defer action with regard to the Electrical Pavilion at Wembley. The matter ought to be settled before the summer vacation of municipal councils and electrical directors and managers. The amount required in order to ensure an adequate electrical demonstration is large, but it will be forthcoming if all participate who should do so. The purpose is to demonstrate and boost electricity generally, and few undertakings can fail to benefit from such an effort. It may be that some authorities will feel that a purely local show in their own area would bring more direct results to their own particular undertaking, and would not cost more than participating on a revenue basis in the British Empire display. But the occasion calls for a broader policy than that, and we are pleased to learn that although the E.D.A. display scheme was only circulated a week or two ago, the proposal is being well supported in all parts of the country. Some 23 supply undertakings have pledged their support, and definite recommendations for co-operation have been made by several other municipalities and companies. We hope that the movement will gather force, and that rapidly, as time is of the first importance. The holiday season is upon us; after that if sufficient financial support is assured, those who will be responsible for the details can get on with their magnificent work. It will be a pity to spoil the ship for a ha'porth of tar, or for the electrical hare to slumber while a tortoise gets there!

The Powers of the P.M.G.

As a rule, where a new statutory enterprise is under way, the undertakers thereof are laid under obligation not to interfere unduly with other people's rights and property, or if such interference is unavoidable, they are required to compensate the owners for the injury to their interests. These stipulations naturally relate to property which is already in existence. The Post Office, however, is in a privileged position, for electricity supply undertakers must guard against affecting injuriously the working of a telegraph and telephone line "whether that wire or line be or be not in existence at the time of the laying down or placing of the electric lines or other works" (Electric Lighting (Clauses) Act, 1899, Section 20). And if a dispute arises under this provision, the arbitrator may require the undertakers to make such alterations in their works as are necessary in order to comply with the Act. This would appear to be an extraordinarily wide and even oppressive privilege, rendering the unfortunate undertaker liable to contingencies of which he can form no definite conception at the time when his work is in progress. Happily, however, there is a loophole for escape: the arbitrator may not require such alterations to be made if he is of opinion that the Postmaster-General's lines have been laid "in unreasonable proximity" to the previously existing lines of the undertakers. By this saving clause, therefore, it is recognised that after all the P.M.G. does not own the whole earth and the fulness thereof, though the under

takers still have to bear the onus of convincing the arbitrator that the P.M.G.'s work has been "unreasonably" performed.

The matter has a bearing on the use of the lead sheathing of single-core cables for the return current in rural areas, as suggested by Mr. A. Hugh Seabrook and recently commented on in our pages. As we then pointed out, there are not many telegraph or telephone lines in country districts, and it might often be possible to avoid those that existed—but what of the future? Reliance would have to be placed on the "unreasonable" proviso.

However, a better plan would be to carry out a few experiments with the aid of existing cables, which would, in our opinion, show that the electricity supply alternating currents would not injuriously affect the Postmaster-General's property.

It is interesting to note that the use of the earth as a return—so widely practised in the case of electric traction—is contemplated also in connection with electric lighting, in the same section of the Clauses Act; the undertakers are required, in giving notice of their intention to lay mains, to state "the extent to and manner in which (if at all) earth returns are proposed to be used," and may be called upon to adopt such precautions as will prevent injurious effects on communication through wires already installed, by complying "with such reasonable requirements as may be made by the owner," the "reasonableness" being here also in case of dispute a matter for the arbitrator. It appears, therefore, that the Postmaster-General has a right to be consulted, where his lines exist, but has not the power to forbid the use of the earth return.

A similar suggestion was made by Mr. C. Turnbull at the I.M.E.A. Convention, the object in that case being to convert a three-wire d.c. cable into the equivalent of a four-core a.c. cable by using the lead sheathing for the neutral conductor.

Finland and Electric Traction.

As will perhaps be remembered, it is proposed to convert the State railways in Finland to electric traction and to obtain a supply of energy for this purpose from the Government hydro-electric works at Imatra. Asked as to the present position of the matter, Mr. J. Castren, general director of the State Railways, is reported to have stated that the transformation of the railways engaged the attention of a former director last year, assisted by a German expert. The investigations were suspended owing to the retirement of this particular official, but are to be resumed in the near future. At present the work at the Imatra power station is progressing so quickly that preparatory measures have already been taken with a view to the acquisition of the turbines and generators. The State railways must have their electrification project ready before the power station is completed. In the first place, the idea is to electrify the local lines near Helsingfors and then to proceed with the long-distance lines, taking the section between Helsingfors and Systerbäch as a first instalment.

Small Firms and the Wembley Exhibition.

A FORTNIGHT ago we suggested here that small firms which found the expense of a separate exhibit prohibitive might join in co-operative displays, the cost of representation being thus distributed over a number of them. In addition to favourable communications that have reached us, probably others have been sent by interested parties direct to the Exhibition authorities. We desire to draw the attention of all who have this subject in mind to the report that appears elsewhere in this issue of a conference of Birmingham firms called together on Tuesday last by the B.E.A.M.A. It is now made clear that the co-operation of anybody engaged in British electrical or allied manufacturing is cordially invited. It is quite certain that the Exhibition will be incomplete, and far from representative, if the smaller manufacturers are not included, and we hope that they will now consider their position in the light of the new information that has been advanced by Mr. Crampton on behalf of the B.E.A.M.A., and will decide to avail themselves of one or other of the suggestions that are before them.

The Broadcasting Report.

THE announcement that at last the Broadcasting Committee, of which Major-General Sir Frederick Sykes is chairman, after holding 23 meetings is now considering its report will be received with relief by the manufacturers, traders, and workpeople who are suffering so severely from the "slump" which has prevailed during recent months, and which will not be replaced by renewed activity until the situation has been cleared. The thousands of unlicensed patrons of the broadcast entertainments will likewise be interested in the forthcoming report; it was mainly on their account that the Committee was appointed, but the Committee decided that the only satisfactory way to deal with the matter was to hear all the evidence and report on the subject as a whole.

It is probable that the drafting of suitable recommendations has been by no means an easy task, as the subject bristles with difficulties, and it is not likely that permanent solutions will be found for them at the first attempt; but it is urgently necessary that a reasonably stable basis shall be found as quickly as possible, which can be amended as may be necessary in the light of experience. Already a number of firms that embarked on the manufacture of receiving apparatus at an early stage in the development of the business have been compelled to close their doors, and even in the case of those firms that have been fortunate enough to pull through their troubles up to the present, a large number of workmen have perforce been thrown out of employment. Unfortunately, the counter-attractions of the summer which has at last broken out are likely to hinder the revival of trade in this class of work, but the sooner stable conditions are secured and confidence is restored, the better will be the prospects of brisk business in the autumn.

Inter-Connection of Belgian Ironworks.

A MOVEMENT for securing greater economy in working in connection with certain Belgian iron and steel works was started a few years ago, and was actually inaugurated in 1922 by the formation of the Société Co-operative, Union des Centrales Electriques at Liége. It had been found that when utilising blast-furnace gases in gas engines, all the gas produced was not consumed, while where the engines were employed for driving two generators it was necessary to keep a third set in reserve. These considerations led to the idea of grouping together the works having gas engines or steam engines and of reducing the number of generators by discarding some of the reserve sets. The first experiments were begun in May, 1922, when the interchange of energy amounted to 28,000 kW-hours, and such progress was made that the quantity reached 2,826,000 kW-hours in April, 1923. The distribution of the energy from the different generating plants, which also utilise coke-oven gases and which are interconnected by cables, is controlled from a substation in Liége, the total power available being 65,000 kW. The exchange of energy takes place in the form of three-phase current at 6,300 volts and 50 cycles, the current being transformed by the works themselves. As a money-earning undertaking, the Union plays no part whatever, and consumers pay for energy according to the difference between two scales relating to the actual cost of production of the supplying works and the cost which it is estimated would have been incurred by the consuming works if the latter had generated energy themselves. The capital of the Union is stated to be 7,200,000 fr., and it is possible for works having no generating plant to associate themselves with this co-operative undertaking.

D

THE STARTING TORQUE AND CURRENT OF SQUIRREL-CAGE INDUCTION MOTORS.

By T. F. WALL, D.Sc., D.Eng.

THE squirrel-cage rotor was invented by Dobrowolski* in the year 1889, and there is little doubt that that invention, providing as it did an alternating-current motor of remarkable simplicity, robustness, and reliability, has been largely responsible for the rapid progress of the industrial applications of the electric drive during the last three decades.

In all essential respects the modern squirrel-cage motor differs little from its earliest forerunners. It still suffers from one serious drawback, and if this defect were removed, there would probably be a greatly increased demand for this type of motor.

The great disadvantage of the squirrel-cage motor is the fact that if it is started by switching directly on to the mains, the current taken at the moment of starting

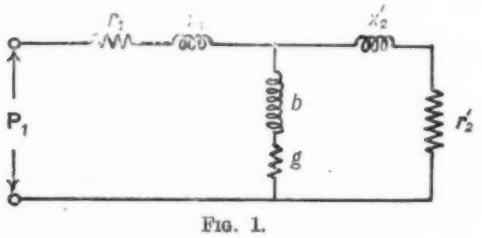


FIG. 1.

may be five or six times greater than the normal full-load current. It is not surprising, therefore, that supply authorities in this country object to any but the smallest size of motor being started in this way. If no restrictions were placed on the size of squirrel-cage motors which it was permissible to start by connecting directly on to the mains, the heavy rush of current, aggravated by the low power factor, might seriously disturb the voltage regulation of the whole system.

It is necessary, therefore, to start squirrel-cage motors (other than those rated at a few horse power) by switching them on to a reduced supply pressure, *e.g.*, from an auto-transformer. When the supply pressure is so reduced, however, the strength of the rotating field in the motor air-gap is correspondingly reduced, and consequently the starting torque will usually be diminished to such an extent that the motor will not start under full load. It therefore becomes necessary to start the motor on light load and then, by means of a centrifugal clutch or similar device, to throw on the load when the motor has run up to speed and is directly connected to the full supply pressure. Such starting accessories, however, increase the first cost and also reduce the simplicity of the motor, and so rob it of its most distinctive features.

Medium and large size induction motors are usually made with wound rotors, and provided with slip-rings so that starting resistances may be connected in series with the rotor, serving the double purpose of limiting the starting current and also increasing the starting torque.

For many years efforts have been made to remove the disability of the squirrel-cage motor by attempting so to construct it that it may automatically have a high resistance at starting and a low resistance at normal running speed. One of the most interesting methods for this purpose seems to have been suggested first by Hobart, who drew attention† to the possibility of using the well-known "skin effect" for this purpose. In one arrangement Hobart suggested that iron conductors might be used for the rotor. Briefly, the idea was as follows: At the moment of switching on to the supply mains, the currents induced in the rotor conductors will be of the same frequency as the supply, *e.g.*, 50 cycles per second. At this frequency the "skin effect" in an iron conductor is considerable, and the effective resistance correspondingly increased. When the rotor is running at its normal speed, the frequency of the rotor currents is very low, *viz.*, the frequency of slip. For example, if the normal full load slip is 4 per cent. and the supply frequency is 50, the rotor currents at normal full load will have a frequency of 2 cycles per second. At this low frequency the "skin effect" is very small, and consequently the effective resistance of the rotor conductors will be practically the same as that given by measurement with direct current. The rotor would thus have the required high resistance at starting and low resistance when running, and consequently the starting current would be reduced and the starting torque increased.

This method appears at first sight extraordinarily attractive. It is entirely automatic, and does not in any way deprive the rotor of its robustness of construction or simplicity.

The fact remains, however, that the method has not found any extensive application, and the chief reasons for this appear to be as follows:—

(i) Iron conductors must have a very much larger cross sectional area than copper conductors for the same conductivity, and hence, if the running efficiency of the motor is not to be impaired, very large iron conductors would have to be used. It is to be observed in this connection that the use of large iron conductors would not necessarily involve a larger rotor because the iron conductors themselves could carry part of the main flux. Large solid iron conductors might, however, give rise to serious eddy currents.

(ii) When the current density is so high as to correspond to 2 or 2.5 times the normal full-load current density, *i.e.*, current densities corresponding to from about 14 to 17 amperes per sq. mm. in copper conductors, the percentage increase of resistance due to "skin effect" becomes so small as to be inadequate for the purpose in view.

(iii) The self-induction of iron conductors will be considerable, and the consequent increase of the reactance of the rotor winding may result in the complete elimination of the advantage of increased resistance, in so far as starting torque is concerned.

Many modifications of Hobart's original proposal have

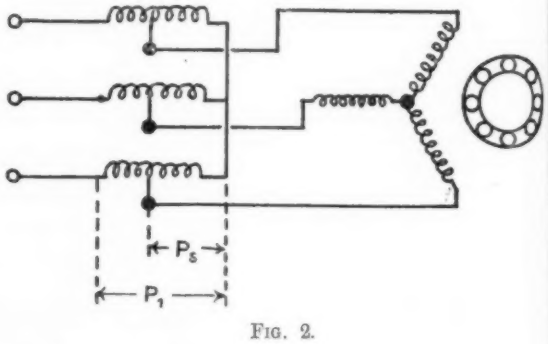


FIG. 2.

been attempted but, so far, do not appear to have met with much practical success.

There is reason to believe, however, that means will shortly be disclosed which will satisfy the requirements, and the purpose of the present article is to show, from theoretical considerations, what conditions are necessary and sufficient to give to the squirrel-cage motor the required characteristics of high starting torque and low starting current.

When an induction motor is at rest it is, in effect, a short-circuited transformer, and each phase may be represented by the equivalent circuit shown in fig. 1.

* D.R.P. patent No. 51,083 of 1889.
† British Patent No. 8,476 of 1900.

Let r_1 ohms per phase be the resistance of the stator winding.

Let x_1 ohms per phase be the reactance of the stator winding.

Let r_2 ohms per phase be the resistance of the rotor winding when reduced to the stator number of turns and phases.

Let x_2 ohms per phase be the leakage reactance per phase of the rotor winding at standstill and when reduced to the stator number of turns and phases.

Let g ohms per phase be the conductance corresponding to the losses.

Let b ohms per phase be the susceptance corresponding to the main flux of the magnetic circuit.

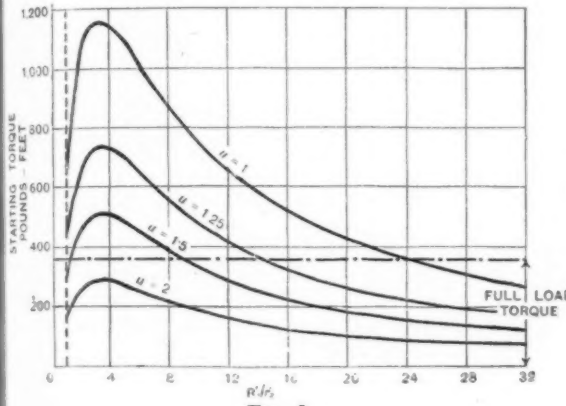


FIG. 3.

Then $z_1 = r_1 + j\,x_1$ is the vector of the stator impedance per phase, and $z'_2 = r'_2 + j\,x'_2$ is the vector of the impedance of the rotor winding per phase when reduced to the stator number of turns and phases.

Further, $Y = g - j\,b$ is the admittance vector which is a measure of the magnetising current of the motor.

It may be shown that the vector of the stator current at starting is given by

$$I_{1s} = P_1 \left[\frac{1 + Y z'_2}{z_1 + K z'_2} \right] \quad \ldots \quad \ldots \quad (I)$$

where $K = 1 + Y z$.

To a fair degree of approximation, the starting current may be written $I_{1s} = P_1 / z_k$ amperes per phase ($I a$) where $z_k = (r_1 + r'_2) + j\,(x_1 + x'_2)$, and is very approximately the short-circuit impedance of the motor.

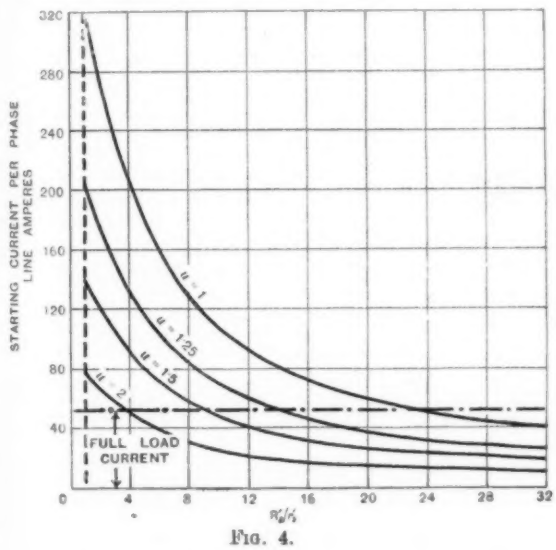


FIG. 4.

The starting torque may be written:—

$$T_s = \left[\frac{m_1 P_1^2 r'_2}{(r_1 + K r'_2)^2 + (x_1 + K x'_2)^2} \right] \left[\frac{0{\cdot}737}{2\pi n_1} \right] \text{lb.-ft.} \quad (II)$$

where m_1 is the number of phases in the stator winding, and n_1 is the speed of the rotating field in revs. per second.

The starting torque is given approximately by the formula:—

$$T_s = \frac{m_1 P_1^2 r'_2}{z'^2_k} \cdot \frac{0{\cdot}737}{2\pi n_1} \text{ lb.-ft.} \quad \ldots \quad (II\,a)$$

If the pressure applied to the stator terminals is reduced by means of an auto-transformer, as shown in fig. 2, then if

P_1 volts per phase is the mains supply pressure,

P_2 volts per phase is the pressure at the secondary terminals of the auto-transformer,

u is the transformation ratio,

$P_1 = u\,P_2$, and $I_{1s} = u\,I_{ls}$,

where I_{1s} amperes per phase is the stator current at starting, and I_{ls} amperes per phase is the line current at starting.

The starting current in the stator and the starting torque may therefore be found from formulæ (I) and

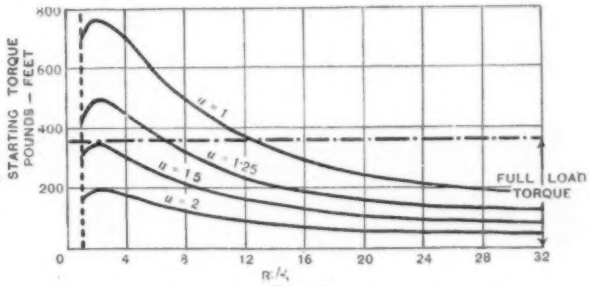


FIG. 5.

(II), or the approximate values from the formulæ ($I a$) and ($II a$) for any value of the transformation ratio u.

Now, suppose that, by some means, the resistance of the rotor conductors may be made to assume an increased value at starting, so that R'_2 ohms per phase represents the starting resistance of the rotor when reduced to the stator number of turns and phases.

Then R'_2/r'_2 represents the ratio of the starting resistance to the running resistance of the rotor winding.

At starting, therefore—

$$z'_2 = R'_2 + j\,x_2.$$

By assuming different values for the ratio R'_2/r'_2, it is possible, from the formulæ already given, to determine the starting torque and the starting current from any given value of the transformation ratio u.

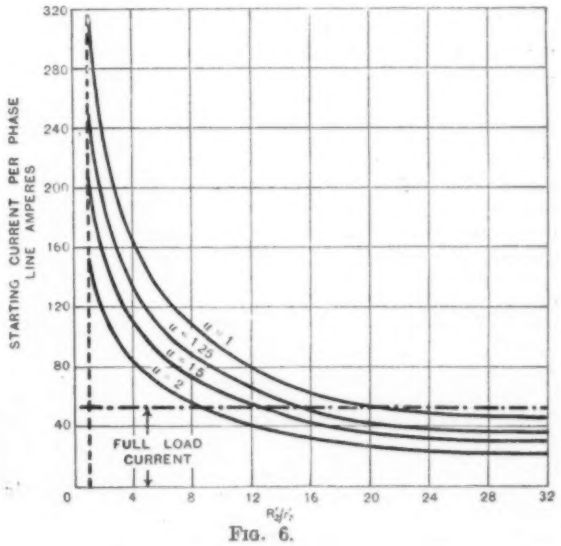


FIG. 6.

Example.—As a numerical example of the application of these formulæ, and the deductions which may be made from them, the case of a 50-h.p. squirrel-cage, 8-pole, 50-cycle, 289 volts per phase, 3-phase induction motor has been chosen.

The respective constants (see fig. 1) of this motor have the following values:—

$r_1=0.129$ ohm: $x_1=0.605$ ohm: $r'_2=0.242$ ohm: $x'_2=0.231$ ohm: $\Upsilon=(0.0038-j\ 0.0476)$.

Case I.—Suppose that the increase of rotor resistance at starting is made without any increase of the inductance of the rotor conductors, that is to say, the rotor reactance at starting remains equal to 0.231 ohm for all values of R'_2.

In fig. 3 is shown the connection between the ratio R'_2/r'_2 and the starting torque for the following values of the transformation ratio u, *viz.*, 1; 1.25; 1.5; 2.

In fig. 4 are shown the values of the starting current in the line as a function of the ratio R'_2/r'_2 for the same series of values of u as in fig. 3.

Some very useful practical deductions may be made from an inspection of the curves of figs. 3 and 4 respectively.

For example, it will be seen that full-load starting torque may be obtained with normal full-load starting current in the line by using a transformation ratio, $u=1.5$, if the ratio $R'_2/r'_2=9$.

Further, if the starting current in the line is allowed to attain twice the normal full-load value and if a transformation ratio, $u=1.5$ is used, then for $R'_2/r'_2=3$, the starting torque will be 1.42 times the normal full-load torque.

This shows how relatively small an increase of rotor resistance is necessary in order to obtain the required starting characteristics for the motor.

Case II.—In the previously-considered case, the increase of the rotor resistance at starting was assumed to be obtained without any increase of the rotor inductance. It is of importance to consider what the effect will be if the increase of the rotor resistance at starting is also accompanied by an increase of the rotor inductance. Suppose, for example, that the added rotor resistance is obtained by means of an added impedance of power factor $\cos\phi_2=0.8$. That is to say, the amount by which the rotor resistance is increased at starting, *viz.*: $(R'_2-r'_2)$, is obtained by a corresponding addition to the rotor inductance of an amount $(R'_2-r'_2)\tan\phi_2=(R'_2-r'_2)\ 0.75$.

By inserting in the formulæ already given for the starting current and the starting torque, the corresponding values of the rotor resistance and the rotor inductance, the curves of figs. 5 and 6 have been obtained.

A comparison of figs. 5 and 6 with the corresponding figs. 3 and 4 of Case I shows to what a very serious extent an increase of rotor reactance impairs the starting characteristics of the motor. For instance, if the starting current in the line is about twice the normal full-load current and if the ratio $R'_2/r'_2=3$, the starting torque will only be about 58 per cent. of the normal full-load torque.

These results show that any device which is used to produce an increase of the effective rotor resistance at starting must increase the resistance without producing any marked increase in the reactance of the rotor.

MECHANICAL AIDS TO COSTING.

By FREDERICK W. POPE.

MECHANICAL and electrical appliances are revolutionising every kind of routine work.

A lecturer, speaking on the building of the Panama Canal, became enthusiastic over the "almost human intelligence" of the mechanical navvies. Before these huge spectacular inventions the compact little calculating machine shrinks into insignificance.

Yet the calculator-typist (if the Editor will allow such a term), becoming enthusiastic over her precise little assistant, might make a similar remark, and clerks of the old-fashioned type might well question what will be their status a few years hence.

Of mechanical aids to costing, the first in order of importance is the time recorder. Time must be recorded mechanically. More—so important a factor is the recorder that it must be considered in relation to the whole system. A clock may be purchased for the recording of daily time, but it does not follow that the same clock can be used for the purpose of labour costing. Indeed, many of the cost accountant's difficulties arise from the fact that suggested methods are not always in harmony with the system; that questions are not always looked at as part of a whole. Costing, it must be remembered, "is interdependent with every other function of the factory," and the time-recorder is as important as the final cost sheet.

It naturally follows that calculating machines should be subjected to the same test. Here we are considering those machines which represent a system of recording, sorting and tabulating, rather than the types which merely calculate.

Hollerith electrical sorting and tabulating machines, although known and used by many British manufacturing firms for several years past, only became known to the general public during the census of 1921. They count and calculate, but more also: they compile statistics. Does a colliery company want to know—quickly—how many tons of coal have been brought up daily, weekly and monthly over a period? How much of this went abroad and how much to home buyers? How much to London and how much to Lancashire? Holleriths are made for the purpose of keeping such information, and of giving it whensoever it may be required.

The method, in its very simplest form, may be illustrated.

An engineering firm may require records of the running of the various machines in the shops. It may desire to know the number of hours a certain lathe has run by the week, month and year.

These records would be kept by cards, upon which a series of digits from 0 to 9 are printed. The process might almost be called one of selection, in that the figures required are selected by the punching of holes in a certain order. Lathe No. 4,970 running 94 hours per week would be recorded (by a punching machine) as follows:—

Machine No.	Hours.
000●	0000
1111	1111
2222	2222
3333	3333
●444	444●
5555	5555
6666	6666
77●7	7777
8888	8888
9●99	99●9

Such weekly records having been kept, all cards showing the running times of the various machines may be placed in a sorting machine which, set for 4,970, will separate all cards relating to this number from the rest. A tabulating machine now receives the selected cards and, with simple manipulation, gives totals for such periods as may be desired.

For the purposes of this article the writer has picked out Hollerith machines mainly because they are elec

trical, but also because of the very novel methods they operate. There are, of course, other systems—the "Powers" is one—to which the student of scientific office methods may apply himself.

Expense, the unsleeping partner in every manufacturing concern, has yet to be confronted.

Is there a point where calculating and similar machines become something of a luxury? To give a direct reply to this question is a difficult matter, but it will not be disputed that where there is a considerable amount of routine work, there is also a need for some mechanical aid.

Every aspect of expense may be tested by the simple question: Does it give sufficient return to justify its existence?

Costing should do more. By revealing waste of method and material, by finding the best and cheapest way in every factory operation, the cost department should earn a profit.

Both the Hollerith and the Powers people have made an interesting departure in accommodating users of their various machines. No capital outlay is involved, machines being "hired out only—not sold." The user rents them; the makers take the responsibility of maintenance and repairs.

Many may view with regret the passing of the bookkeeper who sat on a high stool and posted the ledger in copperplate hand, but he has passed, and the letterheading of the British Tabulating Machine Co. gives us a vision of his fair successor.

A BRIEF OUTLINE OF SALESMANSHIP AND THE SALESMAN.

By F. C. PICKARD.

I PROPOSE dividing this survey into three phases:—

1. Salesman of the past.
2. Salesman of to-day.
3. Salesman of the future.

Back in what some people call the good old days, or, in other words, the days before the Great War, the salesman or traveller seems to have been much more of the hail-fellow-well-met type than those whom we meet to-day. Life appears to have been more easy, he was assured that wherever he went orders would be forthcoming from somewhere, and wherever he might stay for the night, good food, a good bed, and good attendance. In fact, life did not appear to have the complex problems of to-day—he did not have to scheme to such an extent as business to-day demands, orders were more easily obtained, turnover more easily and rightly calculated, clients more easily interviewed; in fact, undoubtedly, with few exceptions, he had a jolly good time.

But what of the salesman of to-day? Am I not right in stating that the jolly hail-fellow-well-met sort of chap has given place to a man of much more sober and alert demeanour?

Immediately following the conclusion of the war, our salesmen, with but few exceptions, had a rollicking time of prosperity.

Business was great and easy to obtain—there was, apparently, room for all—then came the slump. And out of the ashes of despondency have arisen men, stern-eyed, stern-lipped, and keen; men whose personality is plainly stamped on their features for all to see; men who know what it is to fight for every crumb from the rich man's table; men who are living examples of nature's first law—the survival of the fittest, fighting daily amidst conditions under which the weakest go to the wall and every large order received is the triumph of wit, sagacity, will-power, and personality.

Prices being more or less equal, but orders very few and far between, conditions naturally breed the type of man whose fighting instincts are strongest and whose staying powers are greatest.

To-day, so many firms exist which manufacture the same class of goods, roughly at the same price, that individualism and personality alone secure orders, coupled, of course, with a good service from the firms a man may represent. Firms can surely no longer say: "You can easily obtain orders." "See who we are!" They have to rely on the man on outpost duty, fighting hard for every bit he gets, and, I am sorry to say, getting little credit from the firm he represents, which, to-day, does not, or will not, recognise that a representative is a power by himself, that customers deal with Mr. ——— and not an organisation, and that only the man whose personality can impress itself permanently on the mind of his customer will succeed.

What of the salesman of the future?

What will be the next type evolved out of the chaotic conditions of to-day?

I can see the day coming when man will more vividly realise the power of the brain he possesses. He will have grasped the true conception of mind control, personal magnetism, thought transmission, and will-power.

The future surely holds an age when salesmen will use the vast resources of the brain, with all its pent-up energy, and release at will such concentration of directional will-power that selling will, even more than to-day, be a battle of the strong, where the really brilliant salesman will grip his customer's mind, play with his thoughts, direct his will, and, let us hope, his pen.

Supreme concentration, super will-power, magnetic personality, and dynamic energy will win the day.

TARIFF REFORM.*

"Look here," I said, "this looks as though it's important."

"What does?" said my wife, from the depths of the newspaper with which she was absorbed in a computation of what she stood to gain in the event of my meeting a violent end, and wondering whether I was worth while. "It's only a silly circular, isn't it," she went on, looking up, "you always take those things so seriously; like Dutch bulbs and those strange papers about foreign lotteries that have nothing but noughts on them."

"No, I'm sure we ought to read this carefully," I replied; "it's a circular from the people who send us our electric light and—listen to this—they actually admit that people aren't satisfied with what they charge—'Believing that dissatisfaction exists in certain cases with the scale of charges at present in use, the opportunity is now presented to you of selecting an alternative basis to the flat rate you are'"——

"Flat rate," she interrupted; "they've sent you the wrong paper; that one's for people that live in flats."

"No, it doesn't mean that," I said, "it isn't the rate for a flat, but a flat rate; it's the rate that's flat."

"Well, you're always saying it's a very high rate; how can it have got so high if it's flat? It sounds absurd."

"Not at all," I replied, "look at the Table Mountain."

"What do you mean, 'Look at the Table Mountain'?" exclaimed my wife with surprise and slight asperity, "don't be so—ah! I see," she added, somewhat hastily, "at any rate how does it go on?"

"'You may elect to be charged on a basis depending upon the rateable value of your house, in which case——'"

"What a funny idea," she broke in, "but it sounds nice and simple, anyway."

"Yes, but what about that bit of land I bought?" I replied. "They're putting up my rates because of that; I don't see why I should pay more for my electric light because we've got an extra bit of garden, do you?"

"No, that's absurd. Do they think we are going to put lights out there to show the things which way to come up at night?"

"Well, we might give a party, you know, and put up those fairy lights round the place," I suggested. "Still, let's

*From *The King's Engineer* (annual journal of the Engineering Society, King's College, London.)

see what other ideas they've got—'Alternatively you may choose to pay on what is known as the Maximum Demand System.'"

"That doesn't sound hopeful," she interposed; "still, it's as well to be frank about it."

"'In this case you would pay an amount depending upon the greatest number of lights you have on at once, together with a small charge in respect of the number of units you use.' That's enough for the moment; let's think it out."

"Yes, it is a catchy bit that. Look here, what about that party you were talking about? Surely they don't mean they would make us go on paying a lot more just because we had a bit of a fling one night and had all our lights on at once."

"It sounds positively vindictive, doesn't it?" I agreed.

"Don't they say 'parties and beanfeasts specially catered for' like you see sometimes? They certainly ought to."

I scanned the paper in front of me, looking in vain for signs of relenting. "They don't seem to," I said, "Let's go on—'A further alternative which has proved popular in some instances is that which is known as the Contract System. Under this you would pay a fixed sum for your supply, the amount of which would depend upon the magnitude of the demand you require to make and which could not be exceeded.'"

"What do they mean by 'making a demand'?" she asked. "I don't understand that."

"I think it means the amount of electricity you want to use all at once," I replied; "it's just their way of putting it."

"Well, it's silly, because you don't have to ask for it; it just comes when you turn the switch on. Besides, how would you know when you were taking all you could? Would they make it ring a bell in the kitchen, or something?"

"Well, you might get your money back then; that would be very attractive."

"What else do they say?" she asked, warming to the subject. "Is there any more about that?"

"Yes, there is a bit. 'The feature of this system that appeals to many,'" I continued, "'is that you pay exactly the same amount however many units you use, or, in other words, you can keep your lights on all night without paying any more, and at all times when you are not using the supply for lighting it can be employed for heating water.'"

"Oh! John, dear, that's just the thing," exclaimed my wife excitedly. "When you are away from home all night I could keep the house a blaze of light and frighten away the burglars."

"You might keep the burglars away, but you'd have the police looking you up to go into the matter."

"I wouldn't mind that; they're nice men. Besides, I expect they'd get used to it."

"So might the burglars," I hazarded gently.

"What was that about heating water all the time?" she asked. "Whatever should we do with all the hot water; we shouldn't have anywhere to put it, should we?"

"No; do they think we are going to sit up having hot baths all night and water the garden with it in the day time? Why, we could boil the vegetables *in situ* through the hose."

"Oh! don't be an idiot. Have they got any more ideas?"

"No, that's the lot."

"I don't think it's much good," said my wife, "I expect we shall have to go on paying at a fat rate, after all."

"You bet we shall," I replied, with a sigh.

C. E. S.

BIRMINGHAM AND THE BRITISH EMPIRE EXHIBITION.

[Explanations to Electrical and Allied Manufacturers.]

CONSIDERABLE interest was taken in a meeting at Birmingham Chamber of Commerce on Tuesday, of electrical and allied manufacturers, who listened to some explanatory remarks by Mr. R. Crampton, representing the B.E.A.M.A., regarding the British Empire Exhibition arrangements for next year at Wembley Park. Mr. Crampton said he wanted to obtain if possible an expression of opinion from the industry in the Birmingham area as to the best way in which it could be represented at the exhibition. There had been a good deal of misconception about the exhibition, very largely on account of the lack of publicity which it had received. He proceeded to trace the history of the exhibition to show that it certainly was not a Government stunt, but was being run by industry; for the only hand the Government had in the venture, which was to be representative of the mother country and her dominions, was a guarantee of £100,000. Similarly, many firms had guaranteed from £5, £10, £20 to £1,000 and upwards. The banks were backing up the scheme, and while its finances were being very carefully watched, there did not seem any likelihood that it would be otherwise than perfectly sound as time went on. A number of people had asked him if they were going to be called upon for their portion of the guarantee. He did not think this would be the case. Mr. Crampton then directed attention to a plan of Wembley Park, showing, among other sections, the machinery and industrial buildings, pointing out that the electrical and allied engineering section had a large area in the Palace of Engineering.

A very large number of the wealthy firms in the industry had taken space, Mr. Crampton proceeded, and incidentally he mentioned that the B.E.A.M.A., which probably knew more about the electrical industry than any other body, had offered to organize the electrical and allied section, and were appointed agents as between the Exhibition Co. and the exhibitors. The company required £1 per square foot of space. He might say, to clear the air, that in organising this section they were going for the industry as a whole, irrespective of B.E.A.M.A. membership, desiring, as they did, that the entire industry should be represented, and considering that the smaller firms were really its backbone. For that reason they very much desired to see the smaller firms exhibiting. Now the less wealthy firms were apt to find that a six months' show such as this—from April 15th to the end of October—was impracticable, and he was there, that day, to try and get a consensus of opinion as to how far small firms would go, and what they wished to do. One firm had taken 8,000 sq. ft. of space, but he did not suggest any of these would stand that expense. Other firms had taken smaller spaces according to their ability to pay or their desire to show their goods. There was one way of being represented at the exhibition, however, at very small expense, and it applied particularly to accessory firms. The arrangement was a series of show-cases, but they could not organise on these lines until they knew who was coming in. They could have a case 7 ft. 6 in. high, with a shelf in front 3 ft. 6 in. deep, and floor space for people to see their goods, which would work out at about £10 a foot run. Thus a 5-ft. case, 3 ft. 6 in. deep and 4 ft. high, would cost about £50 inclusive, which, he suggested was a reasonable proposition. If he might make a practical suggestion, it was that a small sub-committee might be formed in Birmingham to forward matters with the idea of inducing the smaller firms to become exhibitors.

Discussion and questions being invited, Mr. F. H. Skelsey (Messrs. W. D. Wansbrough, Skelsey & Gunther) advocated joint stands, seeing that some firms would wish to be represented but objected to bearing the whole of the expense. In this way, they could arrange for a man to be in attendance the whole time. Half the engineering side making the mechanical portion of machinery was not specially interested in motor manufacturers and switchgear makers, but they might join together. A show-case would not, of course, appeal to some.

Mr. Crampton agreed that these points required airing, and intimated that joint stands could easily be arranged. One firm could book the space required, and the others could send in application forms centring on that space, for the purpose of registration as exhibitors.

Mr. Birkett (Midland Electric Mfg. Co.) thought a show-case without an attendant would have a very limited field of usefulness, and to many even a show-case was pretty expensive for a small firm. He asked was it possible to have show cases in series as an integral or complete exhibit?

Mr. Crampton replied in the affirmative, but as to the B.E.A.M.A. arranging for an attendant to give information, he hardly thought it would work. Mr. Crampton laid stress on the point that this exhibition was not to be regarded merely as a sales agency, but to be looked at from an entirely different view point from most exhibitions. They could not have the same intensity in a six months' exhibition as in one of a few days. The show was more in the nature of a modern museum to display what the country could do, and to keep British goods before potential customers who would, undoubtedly, come from all over the world. It was a medium of publicity which would prove that Great Britain was not knocked out by the war as the Germans tried to make out. The electrical industry must come together and exhibit itself as a definite entity, and this exhibition afforded it a splendid chance to make an impression on prospective buyers. In this connection he reminded them that the 1851 exhibition still had its effect even to-day, a remark which Mr. Skelsey supported by referring to the results of the St. Louis and Paris exhibitions in 1904 and 1900, which Mr. Crampton said were comparable to the one now under consideration.

Mr. Crabtree thought it was a matter of primary importance in regard to show-cases, that there should be letter boxes attached with the names of the exhibitors thereon, if no one was in attendance. Mr. Crampton intimated that this could be arranged, and he later mentioned the co-operative electric supply scheme of the E.D.A.

Mr. Crabtree suggested that a more practical method of setting to work would be to arrange sub-committees for particular sections, instead of purely local general committees, because with such general committees in other centres there would be much overlapping.

The meeting was inclined to favour this view, and replying to Mr. Birkett as to whether the B.E.A.M.A. and other Associations were taking steps to "get their public" there, Mr. Crampton said that the World Power Conference which was to be held would undoubtedly attract people of the highest class in the engineering world. The conference business would cover six weeks, and deal with the production of power and electrical transmission, and also with labour problems connected therewith. Other sections of industry were organising conferences of a similar nature. Mr. Crampton further explained that the authorities laid it down that firms supplying utility apparatus for exhibition services must be exhibitors. As to an exhibitor showing a crane, if he used a motor he should arrange with the motor manufacturer to contribute for showing his name. Concluding, he said what he would like was for the Birmingham people to arrange things and say what they wanted, and then the management would be able to meet them. A tremendous lot of latitude was allowed as to details, and he hoped they would preach the gospel that it was possible to become an exhibitor for £9 as the "ridiculous limit" for six months.

Mr. G. A. Pope (Messrs. Canning & Co.) remarked that in most other instances exhibition proposals had been turned down on account of the expense. No doubt other members were in the same position as himself: He could not give a decision without consulting his co-directors, and he thought a committee could not usefully be formed until they knew who desired to exhibit. He suggested that the respective firms should communicate with Mr. Crampton after they had considered the matter. Another member having spoken in favour of combined show-cases as likely to attract more attention than solo exhibits, and after some discussion of frontages in relation to joint exhibits, it was agreed that the members present should have time to consider the question and write to Mr. Crampton as to their decision before any detailed co-ordinating efforts were undertaken locally; it being understood, however, that the firms represented should, if possible, ascertain whether other firms desired to come forward, especially in connection with joint displays.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

C.T.S. Wiring in Workshops.

With reference to Mr. Philippe E. Peronne's letter of the 6th inst., under the above heading, I think he will find that the chief reason for specifying the use of screwed conduit in workshops is owing to the efficient mechanical protection which is afforded to the conductors, and the reduced shock and fire risks. There are quite a number of excellent wiring systems in use at the present time, their utility and value depending on the peculiar conditions under which they are operated. With regard to the failure of screwed conduit wiring, this may be traced to two main causes: (1) Inferior cable; (2) bad workmanship. Taking cause (1), all V.I.R. wires or cables drawn (or threaded) into conduit should be of 2,500 megohm grade if satisfactory results are to be obtained.

Taking cause (2), it is of the utmost importance that all burrs and sharp edges should be removed from the conduit before installing, and in addition, adequate provision should be made for draining off any moisture which may collect due to condensation. In situations where the walls are permanently damp, conduit should preferably be carried on iron pipe-hangers cemented in the walls, and not fixed directly to the walls. Under very adverse circumstances C.T.S. drawn into galvanised conduit makes as nearly perfect a system as is commercially possible, electrically and mechanically.

Chester, *July 8th*, 1923. **J. H. Sargent.**

The Supply of Electricity in New Districts.

Undoubtedly the question of the supply of electricity to new districts is one which calls for some consideration of the prospective consumer as well as the supply authorities concerned, and in order to convince prospective consumers that it will be practically impossible for them to live in any degree of comfort, or to do business, unless they take advantage of the abundant supply of electricity which is shortly to be available, it is necessary to get an intimate knowledge of these people, and view the situation as they see it, generally from hard fact written thus:— £ s. d.

In order to get the above facts authentic, with the minimum trouble to themselves, let the supply company concerned, who do not run an extensive wiring department themselves (that is, not unless they are anxious to incur a lot of needless expense)—instead of spending large sums of money in canvassing the new district, setting up new and expensive showrooms for the demonstration of heating and cooking appliances, and, with the exception of the wiring installations, which do not pay them, trying to run the whole shoot on their own—consider the following suggestions:—

In the first place, as soon as the provisional order for the supply of a new district has been definitely settled, and work has to be proceeded with, a canvass of the district is necessary, and that is where their contractor friends prove very useful. The supply people must not overlook the fact that they are not the only ones who are interested financially in the supply of electricity, and wherever a new district is under consideration they can rest assured that there is a wide-awake contractor somewhere in the vicinity who, having the same district also under consideration, probably knows a lot more about the prospective consumers than it will be possible for their canvassers to find out by two years' hard work. Obviously, this is the man they want to assist them in getting consumers, and if the contractor is a genuine electrical man, who knows his business, it is up to the supply people to give him all the assistance they possibly can, even to recommending him to consumers he is not in direct contact with, in order that he can always keep busy, and not have to stand aside and watch bogus contractors foisting their cheap shoddy work on to consumers that he has worked hard to obtain, and who have passed him over because he has refused to take them down on their installation.

Let the supply people consider these facts, get hold of their man, back his work against the scamps, and other obnoxious scum that always rises momentarily to the surface wherever a new supply is opened up, and supply him with the following information: (1) Definitely when the supply will be available, (2) cost of service connection; (3) price to be charged per unit (for all purposes); (4) streets to be opened up, and when. Then give him a good supply of application forms, let him have a man to help to canvass the district, and as soon as possible lay the first main; as soon as the people see that cable going in, the applications for supply will begin to arrive denoting the immediate consumers, and in most cases all their requirements will be shown on the form—the contractor will see to that. Further, it must be kept in mind by the supply people that in the districts they supply the contractor or his men are living, meeting the consumer and prospective consumer every day, therefore in helping the genuine contractor to the best of their ability to increase his turnover, they are financially investing nothing in a concern which by making a profit for itself automatically increases their returns.

One more point which to the supply people may seem of minor importance, but which to the prospective consumer is very often of vital importance: Immediately application is made for supply it wants dealing with, not three months after, but *immediately*, and wherever possible a definite reply should be given whether or not power is available. It must be admitted that there is nothing more annoying to a business man than to be held up in extensions of living or business premises, because he can get no definite information, and does not know whether to lay pipes for gas which he has on the spot, or to wire for electricity which he knows not of; and he remembers the case of a friend who sent in an application for a small lighting job, who after much waiting received approval, and had the wiring done and the gas taken out, subsequently being left entirely in the dark for three months waiting for the service connection to be made, &c.

These little incidents are very probably filed away and forgotten by a company selling millions of units a year, but they are evergreen in the memory of the consumer, who unfortunately does not always look with a kindly eye upon a concern which has directly or indirectly caused inconvenience and loss to him.

Therefore, let the supply companies frame a policy of economical charges, prompt attention to all inquiries, fair dealing with the genuine contractors dependant upon their supply for work, and electricity will soon take its rightful place in the community as the only form of power, light, and heat worthy of consideration.

Wombwell, *July 8th*, 1923. **O. R. Skidmore.**

Patents and Inventions.

In your last June publication "Twiceshy" refers to that brilliant article that appeared under the heading: "The Nation and its Inventors," and asks what can be done to remedy this state of things!

It is far from any love of officialism or red tape that I make the following suggestion, but after giving the matter all due consideration, it appears to me that the question of invention can best be dealt with through a Government department or Ministry of Inventions.

If such a Ministry were set up, a board of experts could sit to consider inventions submitted to them. This board should treat all applications in confidence, and should have the power to grant whatever financial assistance was considered necessary in the case of a meritorious invention after the question of priority had been investigated by it.

Research laboratories should be opened for this purpose, and permits granted to experimenters to carry out their own work. A bureau should be opened by the Ministry for inventions that had been carried out and patented under their auspices. Certified results and records should be published which manufacturers could inspect and bid for these inventions.

The board could see that the inventor was fairly dealt with by the manufacturer, and when the deal was completed the cost of experiments could be subtracted, and thus the Ministry could be made self-supporting, and the inventor could be assured that he would get some benefit from his ideas.

Charles M. R. Balbi, A.C.G.I., A.M.I.E.E.

London, *July 4th*, 1923.

The Prospects for Electrical Engineers in Rhodesia.

Would you kindly inform me where I can obtain particulars of the scale of salaries paid to electrical power station engineers (mains, shift charge, and assistants) in Rhodesia, South Africa? Failing this, perhaps one of your readers would be good enough to give the desired information.

D. C.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Internally-Heated Electric Furnaces.

Consistent results, simplicity and certainty of heat control and hygienic considerations have done much to popularise electric furnaces. One of the latest developments introduced by AUTOMATIC & ELECTRIC FURNACES, LTD., 173-175, Farringdon Road, E.C.1, is the "Wild-Barfield" internally heated furnace. This furnace is built on the "unit" principle, with inside or exposed heating coils, designed to permit the construction of electric furnaces of unlimited size. Each "unit" consists of a brick, measuring 4 in. by 4 in., specially shaped so as to dovetail into its neighbours. In the face of each unit of brick are three annular channels. When the bricks forming the heating chamber are assembled, the annular channels present continuous grooves in the walls, floor and roof, and the heating elements in the form of spirals or rods are drawn through from end to end of the heating chamber or tunnel. Reference to fig. 1 shows the construction more

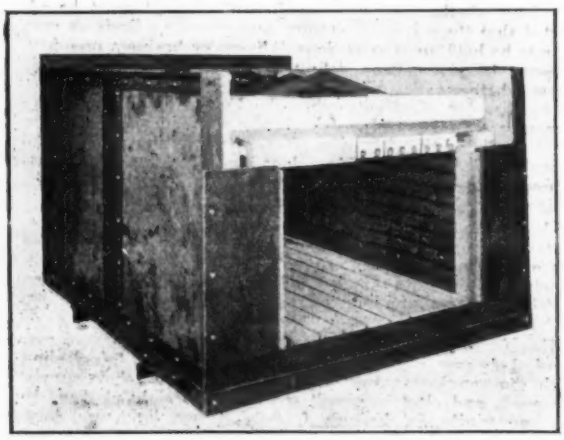


FIG. 1.—THE WILD-BARFIELD FURNACE.

plainly. It will be noticed that the grooves in which the exposed heating elements lie are shaped so that the spirals, whilst free to expand in all directions, cannot come into contact with the work in the furnace.

Special attention has been paid to the roof. The fire brick units are each recessed to hang from trussed girders of specially treated iron or nickel chrome and supporting pieces of nickel chrome with "pick-ups" of similar material.

The furnaces are equipped with a patent automatic cut-out and a thermo-couple, both entering through tubes at the rear.

The control of heat can be easily regulated by the use of switches shown in fig. 2. The heat-resisting lagging is of a special nature, and reduces heat losses to a minimum. The outside casing is constructed of boiler plate, strengthened by angle iron to which it is bolted. The door consists of fire brick in a steel frame, and is usually counterbalanced to facilitate opening and closing. A temperature of 800 deg. C. can be reached in one hour and 1,000 deg. C. in about 1½ hours from cold.

As an indication of power consumption, it may be stated that to heat a furnace up to 1,000 deg. C. measuring 20 ft. by 12 ft. by 12 ft. requires approximately 1,400 kW. A carburising furnace of the same construction measuring 24 in. by 12 in. by 12 in. is heated in one hour to 900 deg. C., with a consumption of 11 kW, and the furnace after the first hour, together with work being carburised, is maintained at 900 deg. C., with a consumption of only 5.6 kW. These furnaces are of considerable use for the heat treatment of locomotive cranks, connecting and coupling rods, billets, plates, carburising, &c., and in annealing both ferrous and non-ferrous sheet, wire, &c., also for baking and kilning pottery ware. They are designed to replace existing gas and solid fuel furnaces of all sizes.

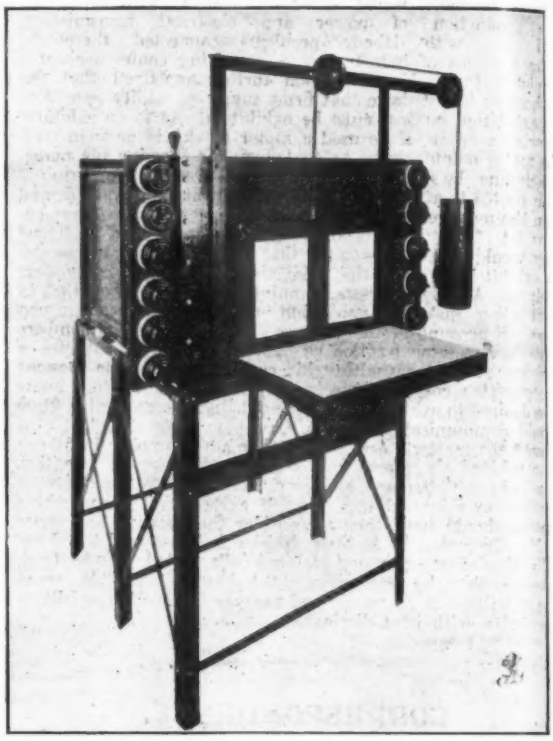


FIG. 2.—FURNACE AND CONTROLS.

An Improved Series-parallel Control for Tramcars.

The standard method of wiring controllers has been in use so long that it would appear to be regarded by manufacturers and operators alike as meeting the requirements satisfactorily; however, there is always room for improvement, and we are informed that an important step in that direction has been made on a large northern tramway system.

At present tramcar motors are arranged so that the field lead FF_2 of No. 2 motor is earthed to the motor case or through the controller. When running in one direction with No. 1 motor leading it has been observed that there is a tendency for the driving wheels to slip, and the car ascends gradients or starts on greasy rails only with difficulty; to increase the adhesion it is necessary to sand the rails, and the energy consumed is greater. If, on the other hand, No. 1 motor is at the rear of the car, the wheels do not slip, the car accelerates smoothly without the aid of sand, and less energy is consumed. Further, under the former conditions the commutator of No. 2 motor becomes scored when going from series to parallel connection, during which process it is short-circuited, but when No. 1 motor is at the rear the transition from series to parallel is made without injury to the commutator. We understand that these are facts with which tramway engineers are well acquainted, but that no remedy has hitherto been found for the troubles indicated, although it is obvious that there is something wrong with a system of control which results in a difference of behaviour depending on the direction in which the car is running. However, we learn that several large cars on the tramway above-mentioned have been wired with a system of motor and control cabling which is free from the defects referred to, and have been running for over six months on a hilly route with entirely satisfactory results. The cars, which weigh 14 tons unloaded, are of the covered-top bogie-truck type; they start without any difficulty, sand is never used to assist adhesion, acceleration is smooth and uni-

form, and greasy rails, curves, and hills are easily negotiated. In addition, it is definitely known that there is a reduction in the consumption of energy, and the driving tires last longer than those fitted to the standard car. The transition from series to parallel is made without jerk to the passenger, and without injury to the No. 2 motor; the commutators remain bright and clean. Circuit-breaker action is quicker on the experimental cars owing to the standard car-wheel slip allowing current to pass through the spinning No. 1 motor. Altogether, the re-wired cars are more economical than the standard car. They complete the round trip in less running time, and they are popular with the operators.

We are informed that the system on which the cars are wired differs very materially from the conventional wiring diagram, and is as readily applicable to four-motor equipments as to the two-motor cars now in use. It has also been developed for the direct and multiple-unit control lines of railway trains, and can easily be applied to existing railway stock. It has been registered at the Patent Office, but unfortunately we are not at liberty as yet to publish the details. The system was evolved by Messrs. W. Edwards, L. Etheridge, and J. A. Baker, members of the staff of a north-country tramway undertaking.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

The Marconi Agreement.—On July 3rd, SIR L. WORTHINGTON-EVANS, in reply to Mr. Becker, said he hoped to lay the agreement with the Marconi Co., with regard to the Empire wireless chain, on the table of the House of Commons as soon as it was completed, but he could not undertake to say that an opportunity for discussion would arise before it became operative. The company at present held no licence covering wireless communication with any countries outside Europe, except the United States and Canada. The licence which was now under negotiation with the company would cover the erection of stations in Great Britain only, and would not be exclusive.

Special Orders.—In both Houses Special Orders, made by the Electricity Commissioners, have been approved for the following places:—The urban district of Mold, Flint; the urban district of Lees, Lancaster; the urban district of Brentwood and parts of the parishes of Hutton, Ingrave, Shenfield, and South Weald, Billericay, Essex; the urban district of Exmouth, Devon; Elgin, Moray; Yeovil, Somerset; the urban district of Crompton, Lancaster; the urban district of Royton, Lancaster; Lyme Regis, Dorset; Mears Ashby, Ecton, Sywell, Earls Barton, and Overstone, Northampton.

West India and Panama Telegraph Co.—On July 5th, Mr. ORMSBY-GORE informed Sir Berkeley Sheffield that the taking-over of the West India and Panama Telegraph Co.'s system by the Government had been considered, but they had been advised that it would not be possible to acquire the system without, at the same time, acquiring certain engagements by which it was most undesirable to be hampered.

Railways (Authorisation of Works) Bill.—On July 6th, COL. ASHLEY, Parliamentary Secretary to the Ministry of Transport, moved the second reading of this Bill, which, he said, enabled him to authorise, without the necessity of a private Bill, expenditure on new works, in any one place by any one company, up to £500,000 instead of £100,000, which was the present limit. The increase, he contended, would do much to relieve unemployment.

The Bill was opposed by many Liberal and Labour members, who held that before such a Bill was passed, better and cheaper travelling facilities should be provided. The Bill was, however, read a second time by 156 votes to 73.

Indian Railways.—During the discussion on the East India Loans Bill on July 6th, LORD WINTERTON, Under-Secretary for India, said, with regard to the electrification of the Indian railways and the curtailment of working expenses, that the latter was being carried out gradually. Electrification, he hoped, would soon be carried out on a large scale in the suburban districts of India.

Lord Winterton's statement was due to a speech by Mr. Milne, who quoted from a report of the Inchcape Committee, as follows:—"We are informed that there are many remunerative schemes, such as the opening up of lines for the development of mineral resources or the electrification of suburban trains. We are of opinion that the country cannot afford to subsidise railways, and that steps should be taken to curtail working expenses."

Private Bill.—The Swanage Gas and Electricity Bill has been read a second time in the House of Commons.

THE METER DEPARTMENT IN A CENTRAL STATION.

BY "INTERESTED."

No more important department can be found in a central station than that having charge of consumers' meters. Revenue is bound to such a department with very strong ties, and efficiency here pays well those who control.

It has recently been my privilege to look over one such department, which can claim justly to be not overstaffed, and the system therein is efficient yet simple.

I have selected one or two cards which will show some links in that system, and which may be found useful to others similarly engaged. The first card "A" (8 in. x 5 in.) is for keeping a "life" record of every instrument received, and the matter printed and ruled in the illustration will explain itself. Briefly, I may say that one card is made out for every meter as it arrives, and its wanderings are duly recorded backwards and forwards from and to consumers until finally relegated to the scrap heap. These cards—I saw considerably over 6,000—are arranged in numerical order of the instruments, and have separate cabinets, or drawers in cabinets, for different makes, and afford at a glance a complete record of every "life."

CARD A.

Meter No.	Type	Amps.	Volts
Fixed at		Date	Reading
Removed from		Date	Reading

CARD B

ELECTRICITY DEPARTMENT.

Name No.

Address

Meter type No. Size

Date.	Reading.	Advance.	Remarks.	Inspector' initials.

CARD C.

BOROUGH OF ——
ELECTRICITY DEPARTMENT
LONDON

METER TEST ON CONSUMERS' PREMISES.

Name

Address

Meter type No.

Amps. Volts

Constant

The above meter has been tested with the following resul

Date Tested by

[P.T.O.

The card marked "B" is just an ordinary meter-reading card for the use of inspectors to record thereon

meter readings. These are on thin boards of various colours. Each district is given a colour so as to facilitate handling and sorting. These thin cards are carried in loose-leaf covers during periods of regular readings, but singly, or a few at a time, in the inspector's pocket—for convenience' sake—at other times when there is no need to carry a number. The size of these cards is about 5½ in. by 4 in., which is a handy size in many ways.

Form "C" is printed both sides, and is for the purpose of recording complaints of inaccurate meters. Whenever a complaint of this nature is received, details of name and address are entered on one of these forms, and the inspector duly fills in the other particulars re number, type, size of meter, &c., and result of test. When this has been carried out and the form returned to the head, a copy of the particulars of the consumer's account for similar periods in the past two or three years is written on the reverse side, and a report duly entered under the heading of "Remarks," from which information is obtained in order to dictate a suitable answer to the complaint. After the test has been duly carried out, these forms are fixed in a binder, so that the chief of the meter department may have them for reference on future occasions, and the actual letters are, of course, returned at once for filing.

WATER-POWER STUDIES.—IV.*

Storage and Pondage.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., M.Am.Soc.C.E.

ONE may have in mind that general matters in hydrology, such as rainfall, run-off, stream-flow, storage, and other considerations affecting the hydraulic end of the hydro-electric system do not and should not concern the electrical engineer. The writer takes the opposite view, based on experience, and points out that there should be no question of doubt on this point, as, in most countries where hydro-electric power is extensively used, adequate experience has already made it definitely understood that these matters do, in general, concern the electrical engineer as much if not more than other branches of hydro-electric practice. For a moment let us look at the matter in a different way. Usually it is accepted that the electrical engineer is as concerned with the whole steam end of the steam-electric system—including general knowledge of the calorific value of, transportation of and delivery of fuel, as well as other considerations affecting steam generation and losses, &c.—as any other branch of steam-electric practice, and that his duties necessarily involve a thorough study and investigation of every item affecting efficient generation and utilisation of steam heat and steam power. Just so with this other branch, the duties of the electrical engineer should commence at the watershed (catchment area), and, just as he or his company (as the case may be) buys the temporary services of a "*purely*" civil engineer to design and build the dam, in like manner the services of a hydraulic or mechanical engineer are obtained to put in the turbines and penstocks, &c., exactly as in the case of the steam-electric system for which a "*purely*" mechanical engineer is temporarily engaged to design, manufacture, and erect the boilers, auxiliaries, steam turbines, &c. The entire hydro-electric system is invariably operated by an electrical engineer trained for such duties and experienced in such matters. The short-sighted policy of forming "water-tight compartments," which was usually to stop at the turbine or at the head works, has completely died out. At the present time we have hydro-electrical engineers, and the near future will add greatly to their responsibilities and number.

As regards the reservoir, its three functions are: (1) inflow or filling, (2) holding, and (3) outflow or using of the supply of water as required.

The main features determining the amount of storage are: (*a*) dependability of water supply; (*b*) the topography, with reference to angle of repose of the ground, &c.; (*c*) the geology, with reference to character of bed and banks of the reservoir; (*d*) the effective depth of reservoir; (*e*) the locality with respect to the development as a whole; (*f*) the character of, and cost of the dam or wall; and (*g*) the cost of inundated land. In working up a study of storage possibilities, it is advisable to cover the whole subject as thoroughly as conditions may require before commencing the development, because inadequate study and investigation may result in complete failure of the hydraulic works and system. Having regard to the great cost of impounding water, it is of the greatest importance that adequate information should exist for estimating (more particularly in the case of the high-head development) the *rate* at which the available precipitation is yielded, and for determining therefrom the best available or most economical storage capacity. (See *Rainfall and Run-off*, to follow.)

In making a reservoir survey, contours of from 4- to 10-ft. intervals are common practice, particularly the former, or 5-ft. contours; very large storage areas have verticals taken to 10 ft. A survey is considered to be good if accurate within the range of 10 to 20 per cent., depending on the reservoir area and its topography. If the profile is plotted to large scale, then all rock-outcrops, as also water levels and estimated height of backwater, should preferably be shown on the contour map. It is important that contours be extended above the highest elevation to which there is any possibility of taking the head-water. In the preliminary survey enough instrument work should be done to permit of plotting a fairly accurate contour plan of the whole area covered by the proposed scheme. If not too complicated, water elevations for extreme flood and low-flow should be plotted on the contour plan or map, and backwater levels should be marked in. A profile should also include section through the dam, intake, &c., and should show the governing features of elevation, such as water-head, crest of dam, and other necessary information. The height to which the dam should be built may be limited by the total cost of flooded land, or perhaps the topography above the site of dam may control the height. It will also depend upon the amount of foundation clearance, amount of freeboard, and full supply and high-flood levels. To ascertain the slope or fall of the stream to the proposed site of dam, elevations of water-level should be read and plotted; these will indicate the approximate location of the dam and head works. For storage capacity, a slope less than 10 ft. per mile is considered good. Special attention should also be given to the reservoir outlet as conditions of foundation material for dam, character of banks, height and slope of banks, section across the stream, &c., may affect the type of and cost of dam, spillway, and complete construction. A good dam-site can often be found below the junction of two streams.

One of the best methods of studying the effect of storage is by means of the mass or *flow-summation* diagram, *i.e.*, by means of a diagram which shows the net available amount of run-off or supply of water to

*Previous articles in this series appeared in the ELECTRICAL REVIEW of February 9nd and 9th, March 16th and 23rd, and June 15th and 22nd, 1923.

the reservoir which has accumulated in a given period of time. That is to say, by summing up the run-off—expressed in any convenient unit—after deducing the observed or the estimated evaporation and seepage losses, the increment for a month, week, or day may be used, depending upon the regularity of the stream flow and the run-off records. The outflow, plus or minus storage, shows directly the net inflow. To determine the capacity of reservoirs with the aid of a topographical map, it is first necessary to know the inflow and outflow of water at different stages of the reservoir for different periods of time, the time interval being made as short as possible to eliminate seepage and evaporation losses. In plotting a reservoir capacity curve, values of the quantity of water stored or released, divided by the change in water surface elevation during the period, may be plotted as abscissæ and the corresponding average stage of the reservoir—elevation of water above the outlet gates—and the quantity of water in the reservoir may be plotted as ordinates, and a curve from these values drawn through the points. At any point on this curve, the area between the curve and the average stage-height is equal to the capacity of the reservoir at that particular stage. The information required for this method, which determines reservoir capacity, is: time-period; mean gauge-height; inflow area; outflow; quantity of water stored; quantity of water released; changes in the water-surface elevation during the period; and elevation of the water surface above the outlet gates. The accuracy of the determination at different stages will depend upon the accuracy of the observed or estimated quantity of water and changes in the water surface above the outlet gates. The quantity of water impounded in a reservoir can also be determined by multiplying the *vertical* distance between the different contour levels with the *mean* area. Or, by summing up the contents between each of its contours, using the approximate formula:—

$$Q^1 = h/3\ (A + a + \sqrt{A \times a}),$$

wherein Q^1 = storage in cubic feet; h = vertical distance between contours in ft.;
A = area of a contour in sq. ft.; a = adjacent contour in sq. ft.

Using a simple method, let us take the following example:—Reservoir area, as found by planimeter, is 24 acres to 600 acres for the different contour levels surveyed to 10-ft. contours, shown as follows:—

Contour level.	Area in acres.	Mean area in acres.
10	24	(draught limit)
20	40	32
30	76	58
40	100	88
50	140	120
60	200	170
70	300	250
80	420	360
90	600	510 (full)

The question is to determine the capacity of the reservoir for the different contour levels up to full capacity. For this case, capacity in acre-ft. is:—

Mean area in acres.	Capacity in acre feet.	Total capacity in acre-ft. for contour levels.
32	$32 \times 10 = 320$	—
58	$58 \times 10 = 580$	900
88	$88 \times 10 = 880$	1,780
120	$120 \times 10 = 1,200$	2,980
170	$170 \times 10 = 1,700$	3,680
250	$250 \times 10 = 2,500$	7,180
360	$360 \times 10 = 3,600$	10,780
510	$510 \times 10 = 5,100$	15,880

15,880 acre-ft.

which represents, in energy, something like:—
$15,880 \times 1.025 = 16,277$ kW for one hour.

In certain countries (this country included) and in certain territories, the value of a given amount of storage is relatively less than in other countries or territories because of the relatively lesser head capable of development. Mountainous countries or territories are more fortunate in this respect, as they offer great differences in elevation within relatively short distances where head can be secured. Obviously, the greater the head capable of development, the greater will be the value of a given quantity of water. Speaking relatively, storage with high head developments is of very great value, much greater than for low head developments.

As shown in the earlier Water Power Studies, power from flow is expressed:

H.p. $= (HQ \times 62.4)/550 = HQ/8.82 = HQ\ 0.1134$ (100% effi.)
kW $= (HQ \times 62.4)/734 = HQ/11.8 = HQ\ 0.0864$ (100% effi.)

from which we may deduce the energy from the storage of this flow to:

H.p.-hours $= HQ/8.82\ T = HQ/(8.82 \times 60 \times 60) = HQ/31,680$
$= 0.0000315\ HQ$ (100% effi.) $= 0.0000315\ HQ$ effi.
kW-hours $= HQ/11.8\ T = HQ/(11.8 \times 60 \times 60) = HQ/42,500$
$= 0.0000235\ HQ$ effi.

Thus, we may write, h.p.-hours $= e(HQ/k)$, and kW-hours $= e(HQ/K)$, wherein, for the usual working conditions, we have:—

e	k	K
60 per cent.	52,600	70,900
65 ,,	48,600	65,300
70 ,,	45,100	60,000
75 ,,	42,200	56,700
80 ,,	39,500	53,000

where Q = cubic feet of water per second (cusecs),
H = effective or net head in feet,
T = time in hours,
e = efficiency in per cent.

Run off in acre-ft. can be obtained from the equivalent factor, 1.0 cusec per day equals 1.984 acre-ft., or, roughly, 1.0 acre-ft. is equal to 0.5 cusec for one day. Also, one acre of water one foot deep equals 43,560 cubic feet. And 1.0 acre of water under 1.0 ft. head will (*theoretically*) produce 1.025 kW-hours of energy or 1.375 h.p.-hours of energy when drawn down 1.0 foot (*see* figs. 8 and 9).

Sometimes the problem is to determine how many hours or days it takes to fill a given reservoir area to a given depth of water. The time in days of 24 hours can be approximately expressed:

$t = Ad/1.984 = 0.5\ Ad$; or $d = 1.984\ t/A$ and $A = 1.984\ t/d$;

wherein A = area in acres *divided* by the discharge in cusecs = area in acres per cusec,
d = depth in feet,
t = time in days of 24 hours each.

(To be continued.)

East Midlands Electricity District.— In relation to the powers which are being sought in connection with the East Midlands electricity scheme, matters were again brought under consideration on Tuesday last, by the holding of an inquiry at Nottingham, by the Electricity Commissioners, regarding the draft order. Sir Harry Haward presided, and was accompanied by Mr. A. Page (vice-chairman), Mr. J. C. J. Dalton acting as legal adviser. The East Midlands Electricity Advisory Board was represented by the Town Clerk of Nottingham (Mr. W. J. Board), the areas concerned including the boroughs of Nottingham, Leicester, Derby, Burton-on-Trent, Ilkeston and considerable territories in Nottinghamshire, Derbyshire, Leicestershire and parts of Staffordshire. Mr. W. Craig Henderson, K.C., appeared for the Notts. & Derbyshire Electric Power Co. The various sections of the Order were dealt with *seriatim* by the Commissioners, and after many points had been discussed, the chairman emphasised the consideration that the Commissioners were anxious to do nothing to interfere with the harmonious working of those forming the Advisory Board. In relation to the claims of the Power Co., he urged that the parties should go into conference, as it would be a most unhappy augury for the success of the Board if at the very outset there was to be wrangling. He thought that Mr. Henderson was too apprehensive in the matter. The Board had already made certain advances since January, and had that day accepted the principle that the transmission lines should be laid as far as possible through the district where the potential load existed. Eventually it was determined that those concerned should confer to see how far an agreement could be arrived at regarding transmission lines, and that the Order should be held up for a month.

BUSINESS NOTES.

Bankruptcy Proceedings.—W. P. YOUNG (W. P. Young and Co. and Leicester Tanning Machinery Co., Leicester), mechanical and electrical engineer.—This matter has already been referred to briefly (ELECTRICAL REVIEW, June 22nd). A statement issued by the Receiver shows a deficiency of £4,331. The causes of failure as alleged by the debtor are: "bad trade; the slump in prices (I was caught with very big stocks at the time of the slump); lack of capital; and very keen competition." In January, 1919, he commenced business in Sanvey Gate, Leicester, as an electrical engineer, under the style of "W. P. Young & Co.," with a capital of £350, the bulk of which was advanced by a friend; in September, 1919, he was joined by a sleeping partner in a further business then started at adjoining premises, under the style of "The Leicester Tanning Machinery Co.," and his partner put £1,500 into this venture as capital. A loss of £1,175 was incurred by the partnership during its first 16 months' trading, whereupon it was verbally agreed that he should pay £550 to his partner, and that the latter should withdraw from the business. Since 1920 he had also traded in a small way at Francis Street, Leicester, as "The Stoughton Motor Supply Co." The usual books of account have been kept, but no trading accounts or balance sheets of the Leicester Tanning Machinery Co. have been prepared since January 31st, 1921. Accounts of "W. P. Young & Co." made up for the 12 months ended January 31st, 1922, disclose the following figures:—Turnover, £16,112; net profit, £1,012; drawings, £850; and capital on January 31st, 1922, £1,071. The debtor states that he did not become aware of his insolvency until early in May last, at which time he was confined to his bed with a serious illness. The unsecured liabilities include 28 debts amounting to £104 in connection with "The Leicester Tanning Machinery Co.," and two debts amounting to £6 15s. 4d. relate to "The Stoughton Motor Supply Co." As regards the remainder, in addition to the ordinary business debts of "W. P. Young & Co.," £1,843, there are 10 cash claims amounting to £3,678, which include £1,638—bills given by the debtor to his late sleeping partner. The debtor, however, does not admit, in the circumstances under which they were given, and in the events which have happened, that he is liable thereunder for more than £707. The "fully-secured" creditor is the mortgagee of the debtor's residence. The "partly-secured" claims are (*a*) bank overdrafts secured by certain policies of assurance and 500 fully-paid £1 shares in the Dixie Hotel, Ltd., and (*b*) for goods in respect of which the creditors claim a lien on a machine held by them.

The following are creditors:—

	£
Armstrong, Addison & Co.	26
Adamant Supplies Co.	11
British Steam Specialities	12
Bentley, D.	34
Clarke, F. W. S., & Co.	12
Coltman Bros.	85
Coltman, J., & Co., Ltd.	15
Leicester Daily Mercury	78
Marfitt, —	20
Norman & Underwood	45
Palmer, C., & Co., Ltd.	25
Perry, G., & Sons	15
Young, C. F., Ltd.	33
Bowell, T. H.	110
George, B.	200
Hewitt, H. J.	1,635
Smith, W.	250
Watson, O. A.	107
Young, E. C.	247
Young, L.	50
British Thomson-Houston Co., Ltd.	54
Berkeley, A.	11
General Electric Co., Ltd.	113
Mayall & Co., Ltd.	19
McGeoch & Co., Ltd.	16
Price's Electrical Supplies, Ltd.	16
Robinson & Hands Electrical Co., Ltd.	20
Beeston Foundry, Ltd.	30
Benjamin Electric, Ltd.	11
Ediswan Electric Co.	98
Ever-Ready Co., Ltd.	23
Fuller's United Electric Works, Ltd.	57
Johnson & Phillips, Ltd.	75
Osborne & Co., Ltd.	20
Perrin, W.	43
Chloride Electrical Co., Ltd.	56
Leroy, F., & Co.	22
Russell, Newbury & Co.	105
Crowther & Sons, L. H.	28
Cleave, H. R., & Co.	48
Simpson, Baker & Co.	15
D.P. Battery Co., Ltd.	128
Mashford, H. C.	12
Messenger & Co., Ltd.	27
Petters, Ltd.	39
Sibley, F. W., & Co., Ltd.	14
Rymer Bros.	16
Rose, H.	450
Walsall Hardware Manufacturing Co., Ltd.	11
Creese, W	545
Garner, A.	79
Bury Felt Manufacturing Co.	29
Murphy & Son, Ltd.	11

The public examination was held on July 6th at the Castle, Leicester, and was adjourned.

WILLIAM HENRY PEASE, Hastings House, Norfolk Street, Strand, W.C., and Welwyn Garden City, Herts., engineer.—This public examination was held at Bankruptcy Buildings, Carey Street, W.C., on July 3rd. The receiving order was made on May 17th, 1923, on a creditor's petition, and the debtor's statement of affairs showed ranking liabilities £7,479 and assets £13,720, thus showing a surplus of £6,242. From April to December, 1914, debtor was in employment as an electrical engineer. He then served in the Army, and was invalided out in September, 1916, when he was employed as an electrical engineer until August, 1917. Subsequently he acted as a director of an aircraft company, and a director of a radiator company. In March, 1921, he obtained an option to acquire a lease of land at Welwyn, Herts., for a term of 999 years, and the lease was granted jointly to himself and another person in March, 1923. The rent of the land was agreed at £10 per acre for the first year, rising to £40 per acre in four years. He agreed that this was a speculation, and that he intended to parcel out the land and let it in building plots. He estimated that his interest in this lease was of sufficient value to pay his debts in full. The examination was adjourned until July 10th.

BRITISH RADIOPHONE Co., Downing Street, Bulwell, Nottingham, makers of wireless apparatus.—The first meeting of the creditors of the above was held on July 6th at the Official Receiver's offices, 4, Castle Place, Nottingham. The statement of affairs showed liabilities of £1,655, against assets of £125, leaving a deficiency of £1,528. Debtors, Norman and Mabel Williams and Walter Cook, attributed their failure to lack of capital, loss by cancellation of a contract, and loss by inability to obtain delivery of raw material. Norman Williams stated that the business was started in partnership on August 1st, 1922. They had none of them any experience in the trade, but they employed a man who understood wireless apparatus. No capital was provided, an overdraft being obtained of £50, and later loans were obtained amounting to about £500. Orders to supply sets and parts were received, and one contract was taken up to supply 300 sets for £615, but debtors were unable to complete this contract, with the result that it was cancelled, and they lost about £100. Then they commenced a mail order business, but had been unable to supply the goods. Creditors started to press for payment, and the stock was sold under an execution. It was stated that they had plenty of orders on hand, but through lack of capital had been unable to execute them. Debtors were ordered to file a cash account and a goods account in respect of their transactions. The creditors decided to leave the matter in the hands of the Official Receiver as trustee of the estate.

PERCY BOSWELL, electrical engineer, 132, Earl's Court Road, S.W., carrying on business as Boswell & Co. at 110, Ebury Street, S.W.1.—Receiving order made on July 2nd on debtor's own petition. First meeting July 19th; public examination November 7th; both at Carey Street, W.C.2.

CHARLES WRIGHT and HERBERT THOMAS WRIGHT, electrical engineers, 251, Fulham Road, Chelsea, S.W.—Receiving order made on July 2nd on creditor's petition. First meeting July 18th; public examination September 11th; both at Carey Street, W.C.2.

WILLIAM H. VEVERS, builder and decorator, and sanitary and electrical engineer (trading as W. H. Vevers & Son), 91, King Street, Maidenhead.—Receiving order made on July 3rd on debtor's own petition.

F. A. WATKINS, electrical engineer, 57, High Street, Hythe.—First and final dividend of 6s. 2d. in the £, payable at the offices of Messrs. Poppleton, Appleby & Hawkins, 4, Charterhouse Square, E.C.1.

C. R. A. CHADFIELD, electrical engineer, 13, Albert Street, Melton Mowbray.—First and final dividend of 9d. in the £, payable at the Official Receiver's office, 1, Berridge Street, Leicester.

F. L. PERRIN, electrical engineer, 57, Wellingborough Road, Northampton.—First and final dividend of 1s. 1½d. in the £, payable at Kingham Chambers, Northampton.

EDWARD E. MEARNS, electrical contractor, 14, St. Bede's Road, East Boldon, Durham.—First meeting July 13th, at the Official Receiver's office, Pearl Buildings, 4, Northumberland Street, Newcastle-on-Tyne. Public examination July 26th, at the County Court, Westgate Road, Newcastle.

THE LACLAND ELECTRICAL MANUFACTURING AGENCY, 68, Great Queen Street, W.C., electrical engineers.—Receiving order made July 4th on creditor's petition. First meeting, July 18th; public examination, November 9th; both at Carey Street, W.C.

JOHN HARRIS, Dugdale Street, Nuneaton, electrical and general engineer.—Last day for receipt of proofs for dividend, July 25th. Trustee, Mr. Charles Band, 9-11, High Street, Coventry.

Company Liquidations.—PERFECTA ELECTRIC, LTD.—Winding up voluntarily. Liquidator, Mr. J. T. Hall, 557, Crookesmoor Road, Sheffield, appointed June 29th. Meeting of creditors July 16th, at 9, Norfolk Row, Sheffield.

PHŒNIX DYNAMO MANUFACTURING Co., LTD.—Winding up voluntarily. Liquidator, Mr. H. S. Wainwright, appointed June 27th. Meeting of creditors July 16th at 26, Park Row, Leeds.

BROOK, HIRST & Co., LTD.—Formal meeting of creditors upon the transfer of the company's business, July 14th at Northgate Works, Newry Park, Chester.

ELECTRICARS, LTD. (In voluntary liquidation.)—Particulars of claims to be sent to the liquidators, Messrs. W. Morris and A. Black, Nobel House, Buckingham Gate, S.W.1, by July 21st.

SIGNAL ELECTRIC Co., LTD.—Meeting of members called for August 7th, at 4, Charterhouse Square, E.C.1, to hear an account of the winding-up from the liquidator, Mr. E. H. Hawkins.

EDGCUMBE BRIGHTEN, LTD.—Meeting of members called for August 3rd (no place named), to hear an account of the winding-up from the liquidator, Mr. A. Nisbet.

CONNER MAGNETO AND IGNITION, LTD. (In voluntary liquidation.)—Meeting of members called for August 7th, at 31, Copthall Avenue, to hear an account of the winding-up from the liquidator, Mr. A. L. Wallis.

CITY OF BIRMINGHAM TRAMWAYS Co., LTD.—Meeting of members called for August 8th, at the Electrical Federation Offices,

88, Kingsway, W.C.2, to hear an account of the winding-up from the liquidator, Mr. Thomas Bower.

VENTIBETA, LTD.—Meetings of creditors and contributories, July 18th, at 33, Carey Street, W.C.

ADNIL ELECTRIC CO., LTD.—Liquidator, Mr. J. H. Stephens, 6, Clement's Lane, E.C.4, released April 27th.

HARRIS ELECTRO-METALS CO., LTD.—Meeting of members, August 11th, at 1, Northgate, Cleckheaton, to hear an account of the winding-up from the liquidator, Mr. B. L. Peace.

AMALGAMATED ELECTRICAL WORKS, LTD. (in voluntary liquidation).—Meeting of members, August 21st, at 59 and 60, Old Bailey, E.C., to receive the report of the liquidator, Mr. T. J. Wilson.

RADOLION MANUFACTURING CO., LTD.—Meeting of creditors called for July 19th at 19, Eastcheap, E.C.

WIRELESS AGENCIES, LTD.—Meeting of creditors called for July 19th at 19, Eastcheap, E.C.

ECONOMIC POWER, LTD.—Meeting of creditors on July 19th at 162, Grosvenor Road, S.W.1.

Dissolutions of Partnership.—WESTMINSTER TOOL AND ELECTRIC CO.—Messrs. A. P. Haslam, A. L. Tester, and J. Williams have dissolved partnership. A new limited company was recently formed, as announced in our issue of June 22nd.

HEYBROOK WELDING CO., Rochdale.—Messrs. H. E. Livesey and J. Fawcitt have dissolved partnership. Mr. Fawcitt will attend to debts and continue the business under the same style.

Trade Announcements.—It is announced in the *Edinburgh Gazette* that the business of REID & CO., brassfounders and electrical engineers, carried on at 108, High Street, Ayr, of which James Alexander Reid and Agnes Moffatt Reid were the sole partners, has been transferred to Thomas M'Culloch and Richard Currie, who will continue to carry on the business under the name of Reid & Co. Accounts owing to and by the old firm will continue to be discharged at 108, High Street, Ayr, on account of Mr. and Miss Reid. Mr. M'Culloch has been in the firm's employment for 23 years.

THE NEW SWITCHGEAR CONSTRUCTION CO., LTD., of Sutton, Surrey, has purchased the assets and goodwill of the Kartret Engineering Co., Ltd., of Southall and Westminster, and it will continue the manufacture of the type of gear hitherto made by the Kartret Co.

THE FLETCHER ELECTRO-SALVAGE CO. has adopted the less cumbersome title of Fescol, Ltd., and has issued a pamphlet dealing with its processes for the deposition of nickel, copper, &c., described in our issue of June 10th, 1921 (p. 763).

Catalogues and Lists.—X-RAYS, LTD., 11, Torrington Place, Gower Street, W.C.1.—A circular letter announcing a new type of "duplitised" film for X-ray work, reducing exposure times.

ELECTRO-DYNAMIC CONSTRUCTION CO., LTD., 4, New Cross Road, S.E.14.—An illustrated pamphlet describing single-phase commutator shunt motors giving unity power factor at full load.

MR. CHAS. W. RICHARDSON, "Reliance" Works, Lower Carts, Stockport.—An illustrated pamphlet dealing with the "Reliance" valveless mechanical lubricator.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., Egyptian House, Piccadilly, W.1.—Accessories Circular No. 86, giving illustrated particulars of hose pipe, dirt strainers, air cocks, tube expanders, &c., for pneumatic tools; and Compressor Circular No. 87, describing "Little Giant" and "New Giant" air compressors.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.—July price list of electrical accessories and materials, including switches, adaptors, cables, domestic appliances, motors, &c.

HOLOPHANE, LTD., Elverton Street, Vincent Square, S.W.1.—A comprehensive catalogue of "Holophane" lighting fittings, with a large amount of illuminating engineering data.

MESSRS. FERGUSON, PAILIN, LTD., Higher Openshaw, Manchester.—Catalogue Section No. 160/A1, giving an illustrated description of oil-immersed motor-starting gear of various patterns.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—July stock list of motors and dynamos.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Circular No. 1,297/1, illustrating and describing "Type S" automatic oil-break ironclad switchgear; Circular No. 1,299/1, describing flexible unit-type air-break ironclad switchgear; also Leaflets Nos. 301/7-1, 301/8-1, 17/1-1a, and 17/1-1d, dealing respectively with panel-type switchboards, d.c. sheet steel cubicle switchboards, commutating pole motors, and d.c. "Type X" commutating pole motors and generators.

G. W. I., LTD., Imperial Works, Shanklin Road, Crouch End, N.8.—Illustrated leaflets dealing with small rotary rectifiers and transformers, and with the renewal of thermionic valves.

MESSRS. EVERSHED & VIGNOLES, LTD., Acton Lane Works, Chiswick, W.4.—List No. 113c, giving particulars of the firm's latest patterns of recording ammeters, voltmeters, and wattmeters.

THE BECCO ENGINEERING AND CHEMICAL CO., LTD., 155-160, City Road, E.C.1.—A booklet (No. 3) dealing with the "Becco-Legg" system of water purification and softening.

STERLING TELEPHONE AND ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 362, a priced leaflet describing the "Sterling" variometer.

Private Arrangements.—G. WILLIAM SALES, trading as Sales & Co., 11, Chichester Rents, Chancery Lane, London, W.C., electrical engineers and contractors.—The creditors interested herein were called together on July 4th at the offices of Messrs. Westacott, Quaife & Co., accountants, 155, Fenchurch Street, E.C. Mr. A. E. Quaife presented a statement of affairs which showed liabilities of £394, made up as follows: Trade creditors, £333; cash creditors, £50; and bank overdraft, £10 11s. 2d. After allowing £20 for preferential claims, the assets were estimated to realise £54, or a deficiency of £339. The assets consisted of: Stock at cost £64, estimated to realise £30; office furniture, fittings, &c. £44, expected to produce £25; and book debts £23, valued at £19. The debtor started trading in December, 1918, at his present address, in partnership. The two partners each introduced £50, but finally the partnership was dissolved, and the debtor had since traded alone. The outgoing partner was paid a sum of £165. Proper books of account had not been kept, and details of the trading could not be given. The drawings had been at the rate of £5 a week. The debtor was not able to make any offer of a composition. The creditors decided that the estate should be immediately realised and the proceeds distributed *pro rata*. The following are creditors:—

	£		£
Dawson, E., & Co.	...	London Electric Stores	65
Electrical Supplies Co., Ltd. ...	26	National Electric Co., Ltd. ...	27
Falk, Stadelmann & Co., Ltd. ...	17	Shenton & Co.	14
General Electric Co., Ltd. ...	84		

SURREY SCIENTIFIC APPARATUS CO., LTD., Shrewsbury Works, Isleworth, electrical engineers and manufacturers of wireless apparatus.—In response to a circular letter issued by the company, a meeting of creditors herein was held recently at Isleworth, when it was reported that the liabilities to the trade and the bank totalled £1,258. The claim of the bank was £298, in respect of which it held securities deposited by third parties. There were also cash creditors to the extent of about £400. The assets consisted of: Book debts, £542, expected to produce £110; plant and machinery valued at £600; and stock, at present market prices, £1,212. It was reported that the present position had been brought about through the company's recently making a big bad debt in Radio Installations, Ltd., which had gone into liquidation. The company was registered on July 28th, 1920, with a nominal capital of £5,000 divided into ordinary shares of the face value of £1 each. The issued capital consisted of 841 shares which were allotted for cash and 440 which were issued for other considerations. There was a mortgage on the company's property, including the machinery, tools, office furniture, &c. The company had been doing a fairly substantial business, and had orders on hand at the moment for immediate delivery of goods to the value of over £300. The company, however, was crippled for want of ready cash. After some discussion it was decided that the meeting should be adjourned in order to enable the directors to confer together with the object of making an immediate cash offer of at least 5s. in the £ to the trade creditors. It was suggested that the adjourned meeting should be held at the offices of Messrs. Corfield & Cripwell, accountants and auditors, Balfour House, Finsbury Pavement, E.C.

Book Notices.—"The Henley Telegraph," March-June, 1923. Price 6d. net.—This bright little staff journal of W. T. Henley's Telegraph Works Co., Ltd., is, as usual, full of interesting and amusing articles and notes.

"Calculations in Heating and Ventilation," by G. S. Coleman. Pp. xix+255; 52 figs. London: Longmans, Green and Co. Price 15s. net.

"Electrical Insulation," by W. S. Flight. Pp. xi+107; 55 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

"The Technology Reports of the Tōhoku Imperial University." Vol. III, No. 2 (62 pp.). Tokio: Maruzen Co., Ltd.—The bulk of the matter in this issue records research work in radio- and audio-frequency currents. Among the papers is one on "The Mercury Arc as the Audio-Frequency Oscillator"; another deals with the behaviour of an aluminium cell lightning arrester under radio-frequency e.m.f.; and a third with the characteristics of the arc of the Tungar rectifier.

"Memoirs of the College of Science, Kyoto Imperial University." Vol. VI. No. 5. Tokio: Maruzen Co., Ltd. Price 1 yen.—This issue contains three mathematical studies.

Prague Industrial Exhibition, 1924.—Czecho-Slovak commercial and industrial associations are organising an industrial exhibition, to be held in 1924 in the building of the Kralovska Obora. The exhibition will comprise 20 sections.—*Reuter's Trade Service* (Prague).

Capital Reduction.—ASSOCIATED FIRE ALARMS, LTD. AND REDUCED.—An Order was made by the High Court on June 19th, confirming the reduction of the capital of the above company from £160,000 to £60,000.

A German Sales Company.—The Electricity and Iron Industry Co. has been formed at Dusseldorf with a share capital of 100,000,000 marks to continue the business of a concern of a similar name in the sale of motors and power-station plant and of iron and steel products. The new company is in relations with, among others, Brown, Boveri and Co., of Mannheim.

Chilean State Railway Contracts.—The Department of Overseas Trade states that the duty of the agent in Paris of the Chilean State Railways Department is to transmit to that Department the lowest price obtained provided the material is in accordance with the Department's specification. A contract may only be obtained by a local agent in Santiago who has quoted a better or the same price as that submitted by the Railway Department's office in Paris, though it stands to reason that tenders presented in Chile are preferred since they are guaranteed by a deposit of 10 per cent. of their value. Large direct contracts have been made through the offices in Paris and New York, and in view of the good results obtained, they will continue to buy direct through them, oils, cotton waste, coke, iron, tin, antimony, zinc, &c., which are very important items in the general tenders. Direct purchases which are to be made immediately by the "Departemento de Materiales y Almacenes," in cases of urgency, only affect manufacturers represented in Chile who have a stock in hand ready to make immediate delivery.

New Zealand's Preference for British Electrical Goods.—The Wellington correspondent of *The Times Trade Supplement* states:—"Over and above the tariff, the New Zealand Government has decided to give a preference of 20 per cent. to British manufacturers over foreign firms for all its electrical requirements. To manufacturers in New Zealand it has decided to give 10 per cent. preference. The Minister for Public Works, Mr. J. G. Coates, recently stated that in connection with the contract for the Mangahao (Wellington) hydro-electric scheme, the following tenders for certain manufactures were received:—

	British.	Foreign.
Exciter sets	£6,072	£5,567
Transformers	16,574	15,630
Waterwheels	78,763	64,430
Sluice gates	3,214	2,972
Totals	£104,623	£88,599

In each case, said Mr. Coates, the British tender had been accepted, although in one instance it was 20 per cent. above the foreign tender. In connection with a Government hydro-electric undertaking in the Waikato district a tender for transformers amounting to £3,310 was accepted in preference to a foreign tender of £2,882. The Minister expressed the hope that local Power Boards, which are concerned with the reticulation of districts using Government current, would show the same practical preference for British manufactures."

Norwegian Cable Manufacture.—The report of the A. S. Skandinaviske Kabel og Gummi Fabrikker, of Aker, states that a department for the manufacture of lead-covered and marine cables has been established at the new cable works. This department is the first of its kind in Norway, and is now in full operation.

Patent Application.—Application has been made to the Patent Office for the restoration of the patent (1,672/15) granted to Albert Holliday and George Edward Ward for an invention entitled "Improvements in electrolytic apparatus for the production of liquor for bleaching and other purposes."

Local Exhibitions.—LIVERPOOL.—The Liverpool Electricity Committee contemplates holding an electrical exhibition at central premises, which have been provisionally secured, for demonstrations of useful domestic electrical appliances. Not only will the exhibition comprise articles of domestic utility, but exhibits likely to be of interest to hotel proprietors and caterers. The range of the exhibition will include cleaning, washing, heating, cooking, and ironing accessories. The Housing Committee has decided, as an experiment, to erect two small houses, which will be equipped wholly on electrical lines. They will only have one fireplace, and the charge for electricity will be collected with the rent.

CORK.—In connection with the Summer Show held in Cork last week, the Mercer Engineering Co., Ltd., of Cork, had on exhibition a range of oil engines, pumps, and electric lighting sets for country-house lighting, manufactured by the Hamworthy Engineering Co., including the "Powerlight" plant.

Annual Sports.—The twenty-eighth annual athletic tournament in aid of the Dublin United Tramways Employés' Provident Fund is to be held at Croke Park on July 28th.

Spanish Zinc Company's Developments.—The Real Compañía Asturiana de Minas has decided to employ a part of the increase of capital voted at the general meeting to the application of an electrical process for the treatment of zinc, in view of which it will be necessary to construct new works and harness waterfalls.—*Reuter's Trade Service* (Madrid).

The Boilermakers' Lock-out.—The Boilermakers' Society, Newcastle, issued on July 11th official figures of its ballot as follows:—

For accepting employers' terms, 7,415; against, 16,859. Majority against resuming work, 9,444.

There is more than a two-thirds majority against resuming work, and the dispute will therefore continue. The union's executive committee is considering a scheme for increasing the lock-out benefit.—*The Times.*

British Trade-Mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the marks may be entered within one month from the dates mentioned:—

Amplion. No. 436,880. Class 8. Telephonic apparatus.—Edward A. Graham, trading as Alfred Graham & Co., St. Andrew's Works, Crofton Park Road, London, S.E. July 4th.

M.V. and M.V.E.C. (lettering and design). Nos. 435,644, 435,645, 435,646, 435,647, 435,648, 435,649, 435,650, 435,651, and 435,652. All goods in classes 5, 6, 8, 13, 14, 15, 16, 18, and 40 respectively. No. 435,653. Class 50. Electric insulators, insulating material, &c.—Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W. July 4th, 1923.

Castaphone (lettering and design). No. 426,739. Class 8. Receivers for use in wireless telegraphy and telephony.—Gordon Castagnoli, 15, Raynes Road, Braintree, Essex. July 4th, 1923.

Telal. No. 436,603. Class 8. Wireless telephonic receiving sets.—Walter Hill, 113, Duke Street, Hulme, Manchester. July 4th, 1923.

Noac. No. 436,658. Class 8. Thermionic valves.—The Electron Co., Ltd., Electron Works, 84, Acton Lane, Harlesden, N.W. July 4th, 1923.

Spiralyte. No. 433,408. Class 13. Electric lamps (ordinary).—British Insulated & Helsby Cables, Ltd., Prescot, Lancs. July 4th, 1923.

Sargossa. No. 437,122. Class 50. Electric insulating material and insulators.—The Siluminite Insulator Co., Ltd., 16, Dowgate Hill, London, E.C. July 4th, 1923.

For Sale.—The Torquay Corporation Electricity Department has for sale a surface condensing plant, complete with air- and circulating-water pumps. (See our advertisement pages to-day.)

Reduced Prices.—THE JACKSON ELECTRIC STOVE CO., LTD., has issued a leaflet giving revised prices of electric irons.

LIGHTING AND POWER NOTES.

Bangor.—ELECTRICITY CHARGES.—The Corporation has applied to the Electricity Commissioners for sanction to increase the maximum charge for electricity to 1s. per kWh.

Birkenhead.—LOAN.—The Finance Committee of the Birkenhead Corporation has approved the proposal of the Electricity Committee to apply for sanction to a loan of £23,307 for the completion of the high-pressure mains, the erection of a sub-station at Prenton, and the installation of rotary converters.

Bradford.—LOAN SANCTIONED.—The Corporation has received the sanction of the Electricity Commissioners to the borrowing of £3,511 for electricity purposes.

The Electricity Committee has decided to extend the mains at a cost of £1,147.

Brighton.—LOANS.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of the following sums:—Buildings, £4,000; plant, £6,630; and mains, £14,170.

Canada.—BRITISH COLUMBIA.—The British Columbia Electric Railway Co. has a scheme in hand for the development of 115,000 h.p. on the Stave River. The scheme will be divided into three sections. The first section provides for the addition of plant to the existing station, with a capacity of 10,000 h.p. The second part of the scheme includes the erection of a station which will develop 25,000 h.p., and the third provides for the erection of a station three miles below the present Stave Falls station, which will have a capacity of 80,000 h.p. The estimated cost of carrying out the scheme is $10,000,000.

Cardiff.—ELECTRICITY SUPPLY.—The Corporation has instructed its electrical engineer to draw up a scheme for the supply of electricity to Llanishen and certain other areas. The estimated cost of laying cables is £20,000.

Cheltenham.—YEAR'S WORKING.—The statement of accounts of the electricity undertaking (engineer, Mr. W. J. Bache) for the year ended March 31st last records a total income of £55,497, as compared with £48,472 in the previous year, and a working expenditure of £28,835, as against £32,264, leaving a gross profit of £26,662 (£16,208). After the payment of capital charges, a net profit of £7,515 was carried to the appropriation account. In 1921-22 a deficit of £2,559 was incurred. The amount of energy sold increased from 2,310,726 to 2,974,354 kWh. The principal item in the capital expenditure of £10,117 was £8,070 for mains and services.

Continental.—ITALY.—The Società anonima Termoelettrica Ligure Piemontese has been formed at Milan, with a capital of 100,000 lire, for the purpose of acquiring a concession to erect a steam generating station (18,000 kW) at La Thuile (Aosta).

FRANCE.—In order to meet the increasing demand for electricity, the Société Electricité et Gaz du Nord, which already operates generating stations at Jeumont and Maubeuge, is

establishing a third station at Aulnoye. In addition, it has acquired from the French Government the power station established at Hirson by the Germans during the war.

Cumberland.—ELECTRICITY ORDER.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order granted by them to the Cumberland Waste Heat Owners' Co., Ltd., authorising the supply of electricity in the urban districts of Egremont and Cleator Moor.

Deal.—SPECIAL ORDER.—The Town Council has consented to the application of Sir Charles Bright & Partners for an Order to supply electricity within the borough. The Council will have the option of purchasing the undertaking within 30 years.

Eastbourne.—YEAR'S WORKING.—The borough electrical engineer (Mr. J. K. Brydges) reports that the total income of the undertaking during the past financial year was £78,186, and the total working expenditure £41,823. These amounts compare well with the equivalent figures for 1921-22—£71,025 and £41,155. The gross profit was thus £41,823, as against £29,870. Capital charges were higher but, nevertheless, the net profit was increased from £9,455 to £18,315. £2,000 was contributed to the relief of rates. A total of £43,225 was spent on capital account during the year, including £20,690 for machinery and boilers, and £18,755 for mains and services. There was an increase of 21 per cent. in the sales of energy, the total being 3,926,099 kWh. Owing to a number of accidents the new turbo-generator, which should have been completed in March last, will not now be ready until the late autumn.

Hazel Grove and Bramhall.—ELECTRICITY IN BULK.—The Urban Council has decided to obtain a supply of electricity in bulk from Stockport Corporation, and has applied to the Electricity Commissioners for sanction to a loan of £40,000 to carry out the scheme.

Horwich.—SPECIAL ORDER.—The District Council has received notice from the Electricity Commissioners granting an Order authorising it to generate and supply electricity and refusing the application of the Lancashire Electric Power Co. Many local authorities are affected by this decision.

Keighley.—ELECTRICITY EXTENSIONS.—The Corporation Electricity Committee recommended that application be made to the Electricity Commissioners for sanction to the installation of a 5,000-kW set in the existing buildings, and new boiler plant. It was also recommended that an agreement be approved with the Yorkshire Electric Power Co. respecting an electricity supply to the Skipton District Council, as submitted by the Town Clerk to the Electricity Commissioners. At a full meeting of the Council on July 11th, the proposed agreement was abandoned.

Leeds.—LOAN SANCTIONED.—The City Council has received the sanction of the Electricity Commissioners to the borrowing of £170,000 for extensions to the power station in Whitehall Road.

Liverpool.—ELECTRICITY EXTENSIONS.—The City Electrical Engineer has submitted a report to the Electricity Committee in which he recommends extensions to the Lister Drive power station at an estimated cost of £500,000. Under the proposed scheme the output of the station would be increased from 50,000 kW to 150,000 kW.

Manchester.—LOANS.—The Electricity Committee proposes to apply to the Electricity Commissioners for sanction to the borrowing of £20,000 for street lighting and £20,000 for mains.

Matlock.—SPECIAL ORDER.—The Electricity Commissioners have granted a Special Order to the Derbyshire and Notts. Electric Power Co., authorising it to supply electricity to Matlock, Matlock Bath, and surrounding districts.

North Wales and South Cheshire Electricity District.—ORDER OF CONSTITUTION.—The Order made by the Electricity Commissioners under Section 7 of the Electricity (Supply) Act, 1919, constituting the above-named district and establishing the North Wales and South Cheshire Joint Electricity Authority, has been issued.

Penmaenmawr.—ELECTRICITY SUPPLY.—The Urban District Council has entered into an agreement for a supply of electricity from the North Wales Power Co. The town supply will be taken through the transformer station of the Welsh Granite Co., which is already obtaining electrical energy from the North Wales Co.

Pickering.—ELECTRICITY SUPPLY.—The Urban District Council has under consideration a scheme for lighting the town by electricity.

Price Reductions.—Reductions in the charges for electricity are being made in the following districts:—

HIGH WYCOMBE. (ELECTRIC LIGHT AND POWER CO., LTD.)—Lighting: 9½d. per kWh for the first 100 kWh per quarter and 9d. beyond.

EASTBOURNE.—Heating and cooking: From 1¾d. to 1½d. per kWh. Power: First 500 kWh from 3d. to 2½d. per kWh; next 500 kWh, from 2½d. to 2d.; next 500 kWh, 1¾d. to 1½d. per kWh; for all energy in excess of this amount, from 1¾d. to 1d. per kWh.

SURBITON.—Lighting: From 9d. to 8d. per kWh.

WIGAN.—Lighting: For all hours' use up to 1,000 per annum, 4d. per kWh, plus 25 per cent.; beyond, 2d. per kWh, plus 25 per cent. Heating: 1d. per kWh. Power: First 500 kWh per quarter, 2d., plus 20 per cent.; next 500 kWh., 1½d., plus 20 per cent.; next 1,000 kWh, 1¼d., plus 20 per cent.; beyond, 1¼d., plus 20 per cent.

Rochdale.—YEAR'S WORKING.—The total revenue of the electricity undertaking (engineer: Mr. F. H. Rudd) during the year ended March 31st last was £185,317, as compared with £186,550 in the previous year. Against this were charged working expenses amounting to £129,090, as against £130,209, leaving a gross profit of £56,227 (£56,341). The capital charges were about double those of the previous year, reducing the net profit from £22,650 to £11,547. The reserve and sinking-fund accounts show balances of £30,843 and £114,469 respectively. During the year capital amounting to £32,606 was expended, principally upon mains and services. The sales of energy showed a large increase—from 21,622,008 to 30,894,047 kWh.

South-East Lancashire Electricity Board.—The winding-up meeting of the South-East Lancashire Interim Electricity Board was held on July 3rd. The first meeting of the statutory board will be held on July 19th, and Sir John Snell, chairman of the Electricity Commission, will preside.

Stafford.—MAINS EXTENSIONS.—The Corporation has agreed to a recommendation that the cables be extended along Lichfield Road to the boundary of the Council's electricity supply area near Stockton Lane at an estimated cost of £3,800.

Swansea.—LOAN.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £30,000 for mains and services.

Torquay.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to the borrowing of £8,500 for mains and meters.

United States.—HYDRO-ELECTRIC DEVELOPMENT.—According to the *Electrical World*, the Utah Power & Light Co. has been granted a provisional permit for the erection of a power station on Green River. A preliminary survey and plans are being made by the company for the construction of the station, which will have a capacity of 60,000 h.p. The estimated cost of the scheme is $10,000,000.

Welshpool.—ELECTRICITY ORDER.—The Welshpool Gas Co. has notified the Town Council that it is applying to the Electricity Commissioners for an Order authorising it to supply electricity in the district. The Council has decided not to oppose the application.

West Bromwich.—YEAR'S WORKING.—The borough electrical engineer (Mr. W. A. Jackson) informs us that the revenue accruing to his undertaking during 1922-23 was £69,762, a decrease of £3,194. Generating, distributing, and other works costs amounted to £45,113, a decrease of £7,511, leaving a gross profit of £24,649, as compared with £20,332. After providing for loan redemption, interest, &c., there remained a net profit of £10,054. In the previous year there was a net profit of £6,775. The number of kWh sold increased by 37 per cent. to 7,211,025.

West Wilts.—ELECTRICITY SUPPLY.—All opposition to the scheme of the Western Electric Distributing Corporation, Ltd., for the supply of electricity to West Wilts., Devizes, and Chippenham has been withdrawn. The Calne Corporation is to provide its own generating station, and has been cut out of the area, which now includes the urban and rural districts of Bradford-on-Avon, Melksham, Trowbridge, Chippenham, Devizes, and Westbury. The companies now supplying electricity at Chippenham, Melksham, and Trowbridge will be absorbed by the Western Electric Distributing Corporation, Ltd., on terms now under consideration.

Wolverhampton.—YEAR'S WORKING.—The report upon the municipal electricity undertaking (engineer: Mr. S. T. Allen) for the year ended March 31st last records a total income of £176,100 and working expenses amounting to £87,719. In the previous year the revenue was £164,552 and the expenditure £94,777. The gross profit was thus £88,381, as compared with £69,775. The net result, after paying capital charges, was a profit of £34,042, as compared with £13,941 in the previous year. Of this amount £24,042 was transferred to reserve, and the balance (£10,000) carried forward. A total of £81,382 was spent on capital account during the year, the principal items being: Mains and services, £30,317; machinery, £25,125; and transformers, £15,307. The energy sold increased by about 66 per cent., being 26,940,142 kWh, as compared with 16,208,656 kWh, but 1921-22 was a "slump" year.

Worcester.—YEAR'S WORKING.—The report of the city electrical engineer (Mr. C. M. Shaw) for the year ended March 31st last shows a total income of £45,659 and a working expenditure of £25,985, as compared with £46,906 and £33,148 respectively in the previous year. The gross profit was thus £19,674, as against £13,758. After defraying the capital charges and charging £688 spent for capital purposes, a net profit of £3,719 remained, as compared with £1,013 in 1921-22. The number of kWh sold increased from 4,583,621 to 5,670,247. The capital expenditure during the year amounted to £38,705, buildings, machinery, and mains and services taking approximately equal amounts. During the year a 3,000-kW B.T.H. turbo-alternator, with boiler plant, was purchased and removed from Southampton, and the re-erection of this is now proceeding.

TRAMWAY AND RAILWAY NOTES.

Birkenhead.—TRACK RENEWALS.—As a part of a scheme for relieving unemployment during the ensuing winter, the Tramways Committee proposes to relay portions of the tramway track.

Canada.—ONTARIO.—The Ontario Government has authorised the construction of an electric railway between Port Credit and Oakville at a cost of $1,065,667.—*Reuter's Trade Service* (Toronto).

Continental.—ITALY.—A company has been formed at Milan, with the style of Società anonima Ferrovia Elettrica dell'Alta Val di Sole, for the construction and working of an electric railway from Malè to Fucine and later to the Tonale Pass.

The outlay of 180,000,000 lire has been authorised for the construction of the following railways:—Cuneo to Ventimiglia, 7,000,000 lire; Fossano-Mondovi-Ceva, 5,200,000 lire; Venetian railways, 46,000,000 lire; Poggio-Rusco-Verona, 2,000,000 lire; Bologna to Florence, 40,000,000 lire; Aulla to Lucca, 12,800,000 lire; Sant Arcangelo to Urbino, 11,000,000 lire; lines in the vicinity of Rome, 3,000,000 lire; Rome to Naples, 36,000,000 lire; and complementary Sicilian railways, 17,000,000 lire.

BELGIUM.—La Société d'Electricité du Borinage has recently entered into a contract with the Belgian State Railway authorities for the supply of electrical energy for the operation of the electrified railways and railway workshops in its area.

SPAIN.—The Compañiá de Ferrocarriles Vascongados, Bilbao, has requested authorisation to electrify its lines, and has commenced negotiations with certain firms in order to obtain estimates. The length of the system is 158 km.—*Reuter's Trade Service* (Madrid).

Doncaster.—PROPOSED RAILLESS CARS.—The Corporation proposes to take up the tramway track on the Bentley route, and to apply for Parliamentary powers to run railless cars.

Gateshead.—ACCIDENT.—A motor-omnibus, carrying visitors to the Royal Show, collided with a tramcar on July 7th. The platform of the tramcar was bent, and glass and woodwork smashed. A number of the passengers received slight injuries.

Lytham-St. Annes.—LOAN.—The Town Council is applying to the Ministry of Transport for sanction to the borrowing of £8,111 for extensions to the car shed at Squire's Gate.

Manchester.—"ONE-MAN" TRAMCARS.—The Corporation is introducing six "one-man" tramcars on certain routes as an experiment.

Southport.—NEW ROUTE.—The Tramways Committee has recommended extensions to the tramway track to link up Eastbourne Road terminus with Liverpool Road, and a new line to the Portland Hotel.

West Bromwich.—AGREEMENT.—The Town Council has entered into an agreement with the Birmingham Corporation, under which the latter authority will operate the tramways for a period of 15 years from April next.

Under the agreement the Birmingham Corporation will operate the tramways in West Bromwich for a period of 15 years. The Birmingham Corporation will provide a service not less than the present one, maintain poles and overhead wires, charge such fares as may be required by West Bromwich (paying them over to the latter), with a proportional division for overlapping, and furnish a monthly statement as to traffic, &c., to West Bromwich.

On its part the West Bromwich Council agrees to supply all electrical energy required for the local service, maintain the tramways and roads, cables, and other equipment, and to pay Birmingham's expenses of working and certain other charges.

TELEGRAPH & TELEPHONE NOTES.

Irish Free State.—AUTOMATIC EXCHANGES.—Mr. J. J. Walsh, the Postmaster-General, in the course of a statement made in Dail Eireann recently, said that automatic telephone exchanges were to be introduced into Dublin very soon, and their introduction into Cork, Limerick, and other places was also likely.

Jugo-Slavia.—CIPHER TELEGRAMS.—H.M. Minister at Belgrade has forwarded a translation of a decision of the Minister of Posts and Telegraphs (No. 27,164 of April 30th, 1923), which permits banks, industrial and commercial undertakings, and commercial agents to make use of a cipher for telegraphic communication in their commercial business, provided they deposit copies of the codes or ciphers they wish to use and their keys with the Ministry of Posts and Telegraphs. United Kingdom firms may consult the translation at the Department of Overseas Trade.—*Board of Trade Journal.*

Spain.—TELEPHONE DEVELOPMENT.—There were 223 telephone exchange systems operating in Spain at the end of December, 1922. These served 81,780 subscribers, of which 23,366 were on State-owned lines and 58,414 on private lines. In 1923, under the existing franchise conditions, 15 of the private systems will be taken over by the Government. These systems have a total of 15,875 subscribers at the present time.—*Commerce Reports.*

Sweden.—TELEPHONE REVENUE.—The net revenue for 1922 from Swedish telegraphs and telephones amounted to 27,750,000 kr., or 7,000,000 more than in 1921.—*Financial Times.*

The Telephone Service.—NEW EXCHANGE.—Telephone development at Esher, Surrey, has outgrown the capacity of the existing exchange, and a switchboard of larger size was to be opened for service on July 10th. It is of modern type with lamp signals, and will accommodate ultimately about 1,000 subscribers' lines.—*Financial Times.*

RADIO-TELEGRAPHY AND TELEPHONY.

Falkland Islands.—COMMUNICATION RE-ESTABLISHED.—The Board of Trade is informed by the British Vice-Consul at Punta Arenas that direct radio telegraph communication between Punta Arenas and Stanley, Falkland Islands, has been re-established. The hours for communicating are from 10.30-11 a.m. and from 6.30-7 p.m. At present messages are only received at Punta Arenas for Stanley, but it is hoped eventually to make arrangements for messages to be sent *via* Stanley to all parts of the world.—*Financier.*

Japan.—RADIO LAW.—For the guidance of British firms interested in the market for radio-broadcasting sets, the acting British Consul at Tokio has forwarded to the Department of Overseas Trade a translation of the Wireless Telegraph Law, stating the purposes for which private installations may be erected and used:—

Article 1.—Radio telegraphs and telephones shall be under Government management. Article 2. The installations mentioned below may be privately installed by permission of the competent Minister of State as provided by Ordinance:—(i) on ships, with the object of providing for safety of navigation, and (ii) the requirements of the specified business of a person between ships used in such business of that person; (iii) for the dispatch or receipt of telegrams on land or ships having no connection for public communication by wire or radio with a telegraph office, with the object of serving the exclusive use of the person installing them; (iv) on land or ships for use in the specified business of the same person between places on land, or between land and ships, where there is no connection for public communication by wire or radio telegraph or telephone, and the provisions of the preceding sub-heading are inappropriate; (v) with the object of use exclusively in experiments; and (vi) apart from those mentioned under any of the preceding sub-headings, considered as being specially necessary by the competent Minister of State.

Article 4.—Privately-installed radio-telegraphs or telephones may not be used for purposes other than those for which they were installed, provided that, as determined by Ordinance, there is no obstacle in the way of their use for communicating accidents to ships, weather reports, time, and other communications considered necessary by the competent Minister of State for the public welfare only.

The newspaper installations are understood to be telephonic; they were permitted for only a limited time under section (vi) of Article 2 of the Law, for the purpose of spreading knowledge of wireless; they are no longer in actual use. Installations for research purposes have been sanctioned at one or two of the Universities. The authorities are, however, making investigations with a view to relaxing the regulations, and are considering the possibility of making arrangements for broadcasting.

Radio-Broadcasting.—AMATEURS' AERIALS.—The Leeds Corporation proposes to seek Parliamentary powers to enable it to exercise "proper" control and supervision over aerials.—*The Times.*

COMMITTEE OF INQUIRY.—The secretary of the Broadcasting Committee announced on Monday last that the Committee, having held 23 meetings and heard a large amount of evidence, was considering the terms of its report, a draft of which had recently been prepared.

Ships' Distress Signal.—The *Board of Trade Journal* points out that the distress signal (S.O.S.) may fail to arrest the attention of watchers when it is made at the normal rate of signalling (1) in congested areas, (2) at very long ranges on the high seas, and (3) when interference is experienced from atmospherics. The prolonged dashes (T.T.T.) used when transmitting the safety signal laid down by the Safety of Life at Sea Convention are distinctive, even when heard in conjunction with other signalling, and if special stress is given to the three long dashes (O) in the signal the difficulty experienced by watchers will be obviated or at least reduced. The first S.O.S. signal should therefore be transmitted for one minute at a rate of about five words, *i.e.*, about eight repetitions of . . . — — — . . . per minute, special attention being given to the sending of long clear dashes. Attention is also called to the great importance of obtaining an absolute cessation of all other signalling in the region of the distress signal at the earliest possible moment.

ELECTRICITY SUPPLY AT EDINBURGH.

THE PORTOBELLO GENERATING STATION.

The Edinburgh Corporation first commenced to supply electricity in the burgh from the Dewar Place generating station in 1895. A second station was built in 1899 in McDonald Road, but by the winter of 1912-13 it was nearing its maximum plant capacity, and the Corporation, in formulating a policy for the future, was advised that as the limits of direct distribution from the generating stations at the normal lighting voltage had been reached, new plant should be installed to produce 3-phase a.c. at high pressure for distribution to sub-stations wherein it would be converted to d.c. for traction, power, and lighting.

In order to have ample condenser cooling water and to facilitate the delivery of fuel by rail from the neighbouring Lothian collieries, a site was acquired alongside the sea at Portobello in proximity to the city. The pre-war plans for the Westbank station provided for an initial equipment of three 5,000-kW turbo-generators, orders for which and for some of the other plant needed having been placed and the foundations of the buildings commenced before the Ministry of Munitions stopped all work. In order, however, to enable the Corporation to meet the growing demand for electricity, it was permitted to instal one 5,000-kW turbo-alternator at Dewar Place and a 4,000-kW set at McDonald Road.

In June, 1919, the Corporation was allowed to proceed with the work, but it was advised by the Board of Trade that the Westbank station should be designed on a larger scale than was originally intended, to provide bulk supplies both within and without the city boundaries. The site is capable of accommodating a maximum plant capacity of 100,000 kW, and the adjoining land, which was also acquired, is sufficient to enable coal carbonisation plant to be erected in future should it be found economical to do so. The capital cost of the new station is approximately as follows:—Land, £42,000; buildings, £300,000; plant, £717,000; seawork, £102,000; and railway sidings, £19,000, a total of £1,180,000, which sum is exclusive of the cost of the city sub-stations that are a necessary complement of the scheme. The cost of land, buildings, and plant for the latter will be about £400,000, including the cost of e.h.p. feeder cables, so that the amount the Corporation requires to borrow in connection with the scheme will be £1,600,000, which debt has to be redeemed out of the revenue of the undertaking within a period of from 25 to 30 years. The station is now in commission, and it was formally opened by H.M. King George V on Wednesday last.

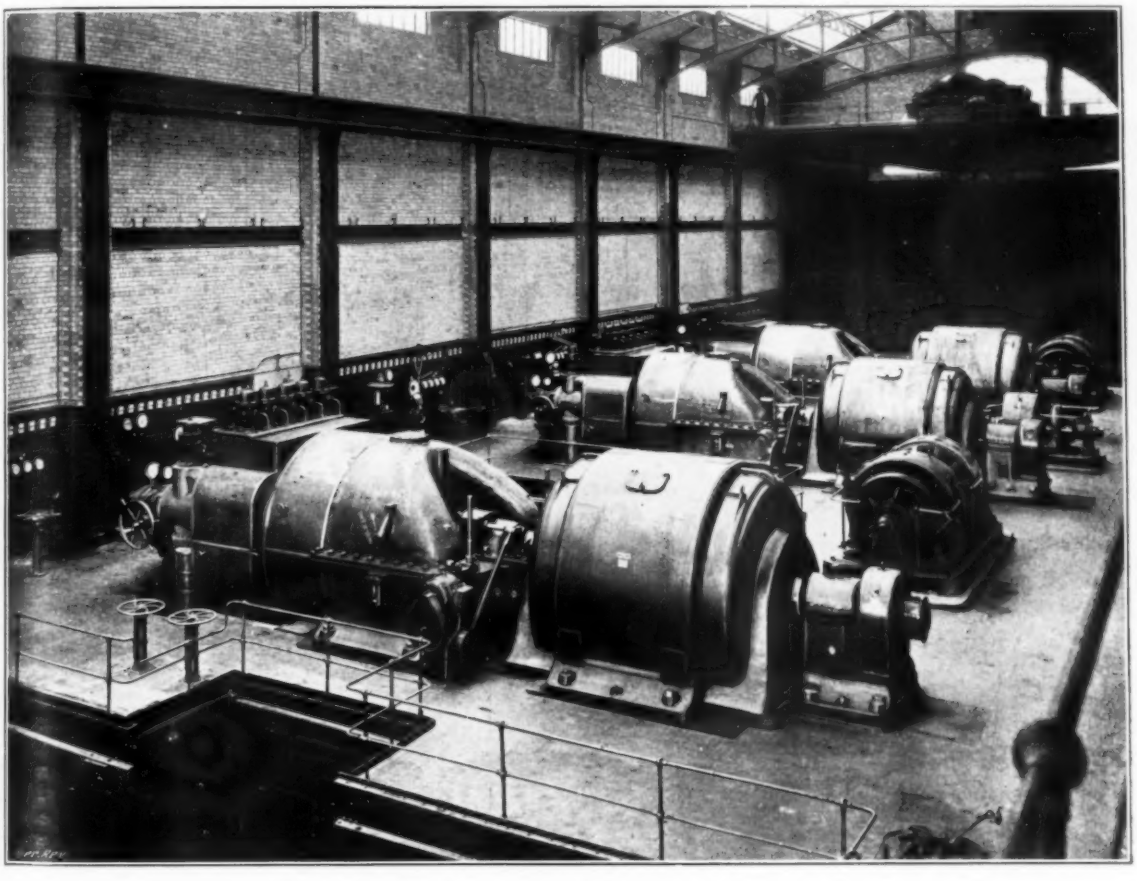


Fig. 1.—Brown, Boveri Turbo-generators at Portobello.

The buildings, designed by the city architect, Mr. J. A. Williamson, are of the steel-frame type with enclosing brick walls; ferro-concrete has been used largely for floors, roofs, &c., and the whole building rests on a monolithic reinforced-concrete raft supported on concrete piles. A railway siding runs into the turbine house, which is spanned by a 70-ton travelling crane, which is operated by three-phase, 400-volt motors and was supplied by Messrs. Marshall, Fleming & Co., Ltd.

The three turbo-alternators at present installed, fig. 1, were manufactured in Switzerland by Messrs. Brown, Boveri & Co., Ltd.: each has a continuous maximum rating of 14,700 kVA, or 12,500 kW, at a power factor

of 0.85, but the highest efficiency is obtainable at a load of 10,000 kW when supplied with steam at a pressure of 290 lb. per sq. in., at a temperature of 690 deg. F. at the stop valve and exhausting into a vacuum of 29 in. of mercury, the speed being 1,500 r.p.m.

The 3-phase, 50-cycle, alternators generate at a pressure of from 6,600 to 7,250 volts, and the cooling air is passed through dry filters in the form of cloth screens supplied by the Premier Cooler and Engineering Co., Ltd. The hot air can be discharged either into the turbine-room basement or through ducts into the boiler-house basement, where it can be passed by the forced-draught fans into the furnaces.

Each surface condenser is provided with duplicate air and water extraction plant, fig. 2, all of which was supplied by Messrs. W. H. Allen, Sons & Co., Ltd. In each condenser there are nearly 5,000 tubes, providing a surface of 15,500 sq. ft., and the quantity of circulating water required at normal full load is 840,000 gallons per hour. The extraction pumps are driven by small steam turbines at a speed of 2,000 r.p.m.; the air-extraction plant is of the steam jet and kinetic types, one of each kind being provided for each set. The extraction pump turbines exhaust into feed-water heaters, through which the condensate is passed on its way to the boiler feed pumps and, in addition, heaters that are fed with steam bled from the main turbines are installed to raise the temperature of the feed water entering the economisers to at least 150 deg. F. A degasser is located between the feed heaters and pumps which removes any traces of air from the water before it reaches the boilers, with the object of minimising corrosion.

A 900-kW steam turbo-alternator has been removed from the McDonald Road station and installed at Westbank station to act as stand-by for supplying the station auxiliary plant; it generates 3-phase, 50-cycle, a.c. at 400 volts between phases, and the turbine is arranged to exhaust to atmosphere, so as to be available for use even if the supply of condensing water is temporarily interrupted.

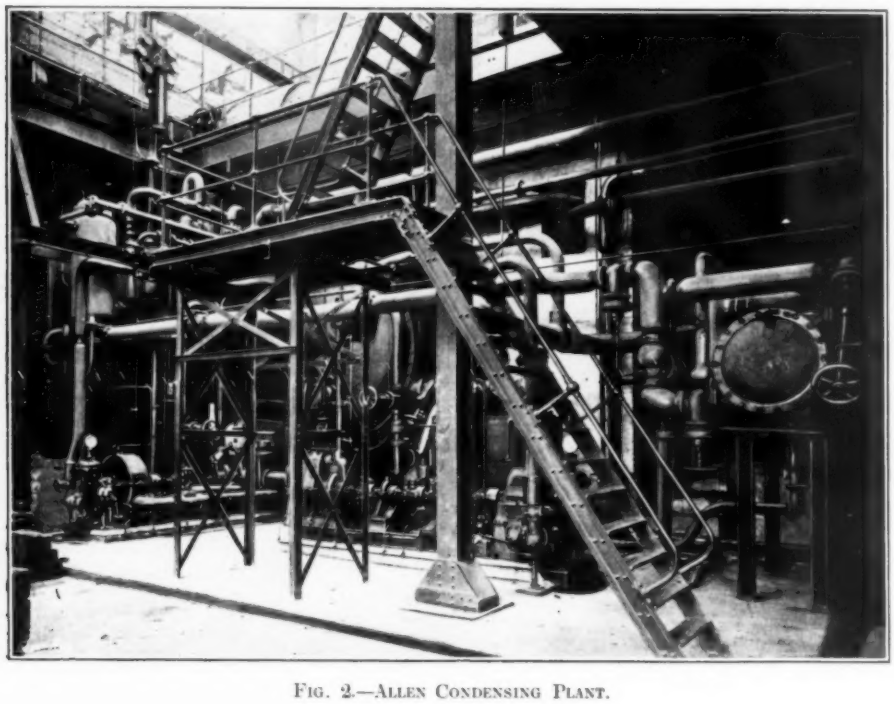


FIG. 2.—ALLEN CONDENSING PLANT.

The boiler house, part of which is illustrated in fig. 5, at present houses six boilers, but there is room in the present building for two more of the same size. They are of the three-drum type supplied by the Stirling Boiler Co., Ltd., and each is capable of evaporating 65,000 lb. of water per hour, or 80,000 lb. under slightly less economical conditions. Superposed economisers with steel tubes and headers by Messrs. Babcock and Wilcox, Ltd., are provided, and three types of stokers have been installed: Boilers Nos. 1 and 2 are fitted with Babcock & Wilcox chain grates; Nos. 3 and 4 with Erith Riley grates; and Nos. 5 and 6 with Underfeed self-contained travelling-chain grates. Each boiler has four grates, and is provided with forced- and induced-draught motor-driven fans.

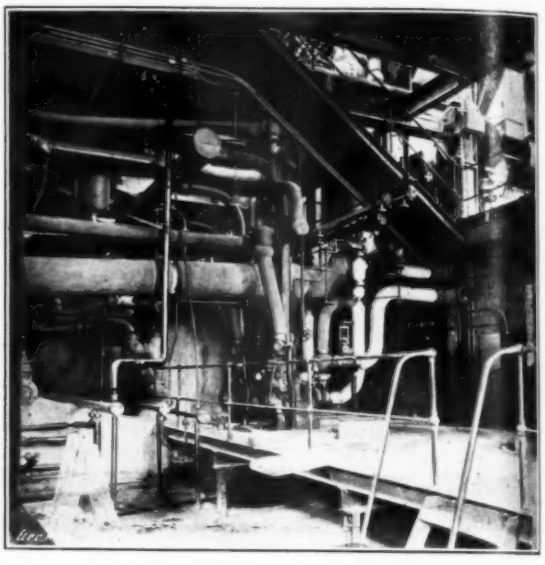


FIG. 3.—WEIR FEED PUMPS.

The boilers are arranged in pairs, two on each side of a firing aisle, and any pair is able to provide sufficient steam for one main turbine when at full load, the steam being generated at a pressure of 300 lb. per sq. in. and superheated to 700 deg. F. Each boiler has a heating surface of 11,160 sq. ft., a superheating surface of 2,500 sq. ft., an economiser heating surface of 5,800 sq. ft., and a grate area of about 400 sq. ft. The boilers are steel cased, lined with fire brick, and the steel cased economisers are carried on an extension of the framing which supports the boilers; above the economisers are the induced-draught fans, and above the latter the chimneys, each boiler having its own fan, but there is only one chimney for each pair of boilers. The base of each chimney forms a dust-catching chamber which prevents the emission of fine ash into the atmosphere. A very complete equipment of instruments is provided to check the performance of each boiler and assist economical operation; they include Lea coal meters, as described in our pages recently, steam flow and feed-water meters, thermometers to record the temperature of both the gases and the feed

water on entering and leaving the economisers, steam pressure and temperature indicators and recorders, instruments for indicating the draught in the grates and uptakes, and for analysing the flue gases. All the instruments indicate at the boiler fronts, while recorders are installed in control rooms at the ends of the firing aisles.

FIG. 4.—COAL TIPPLER.

The boiler feed water is furnished by four turbine-driven centrifugal pumps manufactured by Messrs. G. and J. Weir, Ltd., each of which is able to deliver 18,000 gallons per hour; two such pumps are to be seen in the foreground of fig. 3, which also conveys some idea of the rather congested pipework between the turbo-generators and boiler house.

The coal-handling plant was made by the Mitchell Conveyor and Transporter Co., Ltd., and at Messrs. Fraser and Chalmers Engineering Works, Ltd. The fuel is delivered on to railway sidings capable of accommodating about 60 full and 40 empty trucks. The contents of the trucks are emptied by means of a rotary tippler, fig. 4, into a hopper below the ground level. The coal then falls by gravity on to a rubber belt conveyor, which carries it through a fairly long tunnel beneath the main road to the boiler-house site. The fuel is next discharged on to a second belt conveyor, running at right angles to the first one, which in turn empties it into two hoppers that feed gravity bucket conveyors, fig. 6, which carry the coal up to the concrete overhead bunkers in the boiler house. The first belt conveyor can be made to discharge the coal in such a manner that a travelling jib crane, fig. 7, can pick it up with a grab and place it on the storage ground between the boiler house and sea front, where there is room for some 15,000 tons of coal. The bunkers serving each boiler hold about 80 tons of coal, sufficient to supply one boiler for 14 hours when steaming at its full capacity. The whole of the coal-handling plant is electrically driven, and electric capstans are provided for marshalling the railway trucks, which are weighed before and after they are emptied, so that a record can be kept of the total quantity of fuel delivered to the station.

As the boiler-house basement is on the ground level, the ashes are discharged from the hoppers beneath the boilers into skips, which are pushed by hand into the open, quenched, and then picked up by a telpher and their contents emptied into a concrete hopper, whence they are removed by motor lorries.

An electrically-driven vacuum plant for extracting the flue dust from the boilers, economisers, uptakes, and chimney bases has been installed in the basement; it was supplied by the British Vacuum Cleaner Co., Ltd., to convey the fine dust through pipes to a metal receiver outside the building, wherein it is quenched before being discharged into lorries for removal.

As already indicated, sea water is used for condenser-cooling purposes; the pump house is a separate building near the promenade on the sea front, and is provided with two hand-operated Carrick & Ritchie cranes, the circulating-water pumps and pipework being supplied by Messrs. Worthington-Simpson, Ltd. The three vertical-spindle centrifugal pumps, fig. 8, are each capable of delivering 840,000 gallons per hour, and are driven by 220-h.p. Bruce Peebles motors, the switchgear being by Messrs. Ferguson, Pailin, Ltd. As the system is entirely enclosed, advantage is taken of siphon action to assist the pumps; the water is conveyed from the pump house to the turbine room through four lines of 42-in. bore cast-iron pipes. The large valves, as shown in fig. 9, are electrically operated.

Mr. H. H. Dalrymple Hay assisted with the details of the civil engineering work in the sea, which was carried out by Messrs. C. Brand & Son. Three shafts were sunk at the pump house, and from them three tunnels were driven for a distance of 1,570 ft. to meet three other shafts sunk into the sea bed. Owing to the fact that the bed of the sea shelves very gradually, it was necessary to go out some distance in order to ensure plenty of water at all states of the tide. Normally two sets of shafts and tunnels will be used to draw water and the third to return it; the velocity in the return tunnel will be normally double that in the intake

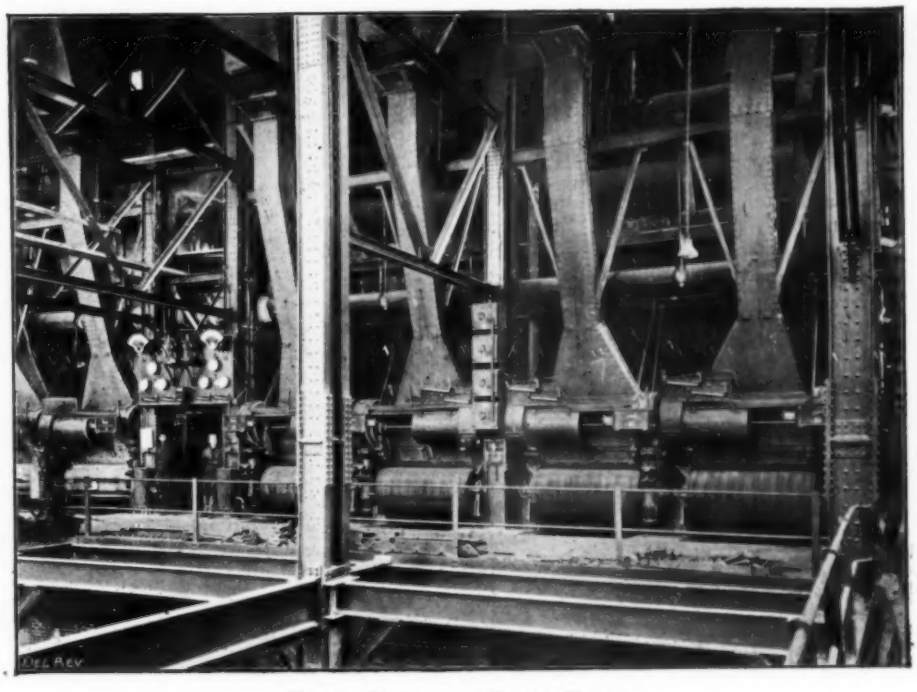


FIG. 5.—PART OF THE BOILER HOUSE.

tunnels, thus tending to scour it and expel anything which may have been drawn into it during the time it was being used as an intake. In emergency and for cleaning purposes only two of the tunnels need be used, and the process of changing over can be done without stopping the flow of water. The shafts and tunnels were constructed in the same manner as those of the London tube railways, being lined with cast-iron segments, the insides of which are covered with cement concrete. The sea shafts are protected by beacons, and

FIG. 6.—BOILER HOUSE EXTERIOR.

their top edges are fitted with machined gun-metal faces, on to which caps can be lowered to seal them and allow the tunnels to be emptied.

The whole of the high-pressure switchgear was supplied by the British Thomson-Houston Co., Ltd. The 6,600-volt busbars, switches, and instrument transformers are located in the basement, and on the mezzanine and ground floors, respectively, of the switch house; all the h.p. circuits are completely enclosed in steel and concrete cubicles, and the oil switches are motor-operated, being remotely controlled from the control room on the gallery floor overlooking the turbine room. The three main turbo-generator panels will be shown in fig. 10, while fig. 11 will show the feeder and tramway boards, fig. 12 being a view of the station board which controls all the 3-phase, 400-volt motors driving the auxiliary plant, as well as the station battery and motor generators. The Pritchett & Gold and E.P.S. Co., Ltd., battery furnishes the necessary power for operating the oil switches and protective devices; it can also be used to light portions of the station in an emergency, and by driving a motor-generator it can provide a stand-by supply for the essential auxiliary plant. It is interesting to note that the same firm supplied a large battery for the McDonald Road generating station, which has been in operation since the year 1900. Normally, however, the station auxiliary motors are (as will be indicated in fig. 13) supplied from the main busbars through transformers supplied by the British Electric Transformer Co., Ltd., which reduce the pressure from 6,600 to 400 volts.

At one end of the control room there is a switchboard for the Portobello tramway section, which is fed from machines at Westbank.

The scheme of distribution involves the provision of four new city sub-stations and also the installation of converting plant at the existing generating stations at Dewar Place, McDonald Road, and Leith (the latter undertaking having been amalgamated with that of Edinburgh in 1920), so that these three generating stations will eventually become sub-stations. The electricity at present generated at Westbank is distributed by nine 3-phase cables, three feeding each of the principal converting stations at Cowgate, Dewar Place, and McDonald Road, each of which is capable of transmitting 4,500 kW at 6,600 volts.

The 3-core cables were made by British Insulated and Helsby Cables, Ltd., and were laid by direct labour under the supervision of the Corporation Electricity Department. They are paper-insulated, lead-covered, armoured, and laid direct with a concrete slab covering, the approximate lengths being 53,000 yards of 0.3 and 10,000 yards of 0.2 sq. in. cable. The sub-station motor converters were supplied by Messrs. Bruce Peebles & Co., Ltd., and the rotary converters by the Metropolitan-Vickers Electrical Co., Ltd., the English Electric Co., Ltd., and the British Thomson-Houston Co., Ltd. The h.p. a.c. switchgear is of the B.T.H. & Metropolitan-Vickers types, and the d.c. gear was provided by Messrs. Bertram Thomas.

Further switchgear, transformers, cables, and overhead transmission lines are to be provided for supplying the Lothians at a pressure of 33,000 volts, but none of the work has yet been commenced, although contracts have been placed as follows:—33,000-volt cables, British Insulated & Helsby Cables, Ltd.; 33,000-volt switchgear, General Electric Co., Ltd.; and 6,600/33,000-volt transformers, British Electric Transformer Co., Ltd.

From the four sub-stations that are to be erected outside the city boundary, the distribution will be undertaken by the National Electric Construction Co., which already has a generating station at Musselburgh, supplying the Musselburgh and District Tramway Co. that is now linked up with the Edinburgh system.

FIG. 7.—COAL-HANDLING PLANT.

At Westbank, Portobello, a step-up transforming station is to be built, which will consist of two banks of three single-phase transformers, each bank having a capacity of 4,500 kW. From this point 33,000-volt cables will be laid as far as Niddrie, thence an overhead line will run to Musselburgh and on to Tranent, and a second overhead line will go to Lasswade and Fordel; later a third overhead line will join Fordel and Tranent, thus completing a ring main.

(To be concluded.)

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Aldershot.—July 18th. Borough Council. 600 yd. of 3-core, paper-insulated armoured cable. (See this issue.)

Australia.—SYDNEY (N.S.W.).—September 24th. City Council. 1,775 d.c. meters (5 to 150 amps.) and 36,200 single-phase meters (5 to 50 amps.).

Step-down transformers and induction motors.—*Reuter's Trade Service* (Melbourne).

November 19th. Storage batteries, regulating switches, copper connections, charging boosters, and switchgear.*

August 8th. Government Railways and Tramways, Chief of the Electrical Engineering Department. Six water-tube boilers, with electrically-driven mechanical stokers, forced-draught fans, &c., for the White Bay power house.*

MELBOURNE.—August 8th. Victorian Government Railways. Three-phase a.c. induction motors, starting apparatus and accessories.*

COMMONWEALTH GOVERNMENT.—Various dates. Cable distributing terminals; bells, cords, and plugs; switchboards; telephone parts; and submarine cable. (See this issue.)

Belgium.—July 18th. Belgian Telegraph and Telephone authorities at La Salle Madeleine, Brussels. Supply and installation of two electric lifts at Malines.

Tenders have this week been invited by the municipal authorities of Bassenge (Province of Limbourg) for the concession for the distribution of electrical energy for lighting and power purposes in the town.

Blackpool.—July 16th. Education Committee. Installation of electric lighting at Devonshire Road schools. Secretary, Education Committee. (June 29th.)

Bristol.—August 1st. Electrical Committee. Self-cleaning water-screening plant (2½ million gal. per hour capacity). (See this issue.)

Canada.—TORONTO CITY COUNCIL.—August 21st. The Council is inviting tenders for the supply and installation, at the Strachan Avenue sewage-pumping station, of two 2,880,000-gal. centrifugal sewage pumps, direct-connected to 3-phase induction motors.*

Canary Islands.—The authorities of the Canary Islands at Santa Cruz de Tenerife have just invited tenders for the establishment of a system of telephonic communication with a number of exchanges throughout the Island of Tenerife.

Edinburgh.—July 23rd. Tramways Department. Supply and delivery of eight top-covered car bodies. Forms, &c., from the manager, 2, St. James' Square, Edinburgh; tenders to be sent to Town Clerk.

Grays.—July 31st. Electricity Department. Two 350-kW converting sets, with two 400-kVA static transformers, and switchgear. (See this issue.)

Hoyland Common (Yorks.).—July 17th. Electric lighting installation, Working Men's Club. H. Dickinson, secretary.

Ilford.—July 24th. Urban District Council. E.h.p. and l.p. switchgear, and l.p. lead-covered and armoured cable. (See this issue.)

India.—CALCUTTA.—Corporation. September 10th. One steam-driven centrifugal pump to deliver 2,000,000 gallons per hour against a head of 44 ft., with all necessary piping, valves, &c., in connection therewith. Copies of specifications, &c., may be obtained from Mr. J. R. Coats, chief engineer to the Corporation, Central Municipal Office, Calcutta.

A sum of Rs. 75 will be charged for a set of three copies of specification, schedule, and tender form, which sum will be returned on receipt of a *bona-fide* tender.—*Reuter's Trade Service* (Calcutta).

London.—LONDON COUNTY COUNCIL.—July 16th. 200 sets of tramcar motors with accessories. (June 29th.)

L.C.C. TRAMWAYS.—August 13th. Supply and erection of pipework and de-aerating plant at Greenwich power station.

ST. PANCRAS.—July 19th. Electricity Department. L.p. d.c. switchboard. (July 6th.)

ILFORD.—July 16th. Education Committee. Electric lighting installation at the Christchurch Road cookery centre and Newbury Park handicraft centre. Mr. A. H. Shaw, electrical engineer.

LAMBETH.—July 24th. Board of Guardians. Installation of electric lighting and fittings at the Renfrew Road relieving station. (See this issue.)

New Zealand.—February 28th, 1924. Contract for Section I. headworks, &c., Arapuni hydro-electric power scheme.*

Pentre, Rhondda.—July 23rd. Rhondda Urban District Council. Three 150-kVA 3-phase static transformers. (July 6th.)

Southport.—July 19th. Relaying with new rails tramway routes in Mornington Road, Derby Road, and Sussex Road (about 1,738 yd. reduced to single track). Specifications, &c., from the borough engineer, Town Hall.

Uruguay.—MONTEVIDEO.—State Electricity Works. August 16th. Electrical accessories.*

No date. Eight overhead transporters.*

Warrington.—July 24th. Electricity and Tramways Committee. E.h.p. sub-station ironclad switchgear, and 12 months' supply of earthenware conduits. (See this issue.)

Wigan.—August 9th. Board of Guardians. Electrical vertical pumping plant, &c. (July 6th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Bradford.—Electricity Committee.

Installation of hot-water heating at the new buildings, Bolton Road sub-station (£835).—Rosser & Russell, Ltd., Leeds.

Tramways Committee.

100 steel tires for tramcar wheels (£297 10s.).—Steel Co. of Scotland, Ltd.
48 tramcar split gear wheels and 48 tramcar pinions (£364).—William Jessop & Sons, Ltd.
9 pairs of points (ordinary), at £97 10s. per pair, and 3 pairs of points (long-heeled), at £112 10s. per pair.—Hadfields, Ltd.

Dartford.—Urban Council.

1,600-kW, 2-phase, 50-cycle turbo-alternator and necessary auxiliaries (£13,150).—Brush Electrical Engineering Co., Ltd.

Dorking.—Westcott Isolation Hospital.

Electric light installation (generating plant, switchboard, battery, and underground cables).—Cyril F. Williams, Farnham.

Northampton.—All Saints' Church.

Installation of electric light and two ventilating fans.—Lowke & Sons, Ltd.

London.—LONDON COUNTY COUNCIL.—Highways Committee. The undermentioned tenders were received for the purchase and removal of electric power station machinery at the Chiswick power station, which was taken over by the Council from the London United Tramways, Ltd.:—

J. Cashmore (Accepted.)	**£4,750**
Midland Iron & Hardware Co., Ltd.	4,379
Maden & McKee, Ltd.	4,150
T. W. Ward, Ltd.	3,572
J. Yallop	2,872
G. Cohen, Sons & Co.	2,625
C. J. Fox, Ltd.	1,375
J. T. Williams & Sons	Incomplete.

Two arc-welding plants of E.L.L. portable type.—Equipment and Engineering Co.

Stores and Contracts Committee. The following contracts have been placed:—

Iron castings for Tramways Department.—Dover Engineering Works, Ltd. James Evans & Co. (London), Ltd. (£810). J. Martin & Son (London), Ltd. (£2,717.)
Steel castings for Tramways Department.—Medway Steel Co. (£2,374).
Electric lamps.—Siemens & English Electric Lamp Co., Ltd.

Fire Brigade Committee. The Committee has accepted the following tender from Tilling-Stevens Motors, Ltd.:—

Provision of a new petrol-electric chassis for a turntable ladder (£1,375); and the conversion from gas to electricity of the drive of two other turntable ladders.

Poole.—Town Council.

Electrical installation at the Corfe Mullen pumping station (£655 10s.).—Hamworthy Engineering Co.

Salisbury.—Town Council. Accepted:—

Installation of electric lighting (£176).—Salisbury Electric Light Co. The Council had previously let the contract to Higginbotham and Son at £110, but that firm declined to be bound down to a penalty clause.

FORTHCOMING EVENT.

Institute of Engineering Inspection.—Wednesday, July 18th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Molecules, Atoms, and Electrons," by Mr. R. P. Wilson.

NOTES.

Storm Damage.—During the heavy thunderstorm which lasted practically the whole of the night of July 9-10th, much damage appears to have been done by lightning. At certain times there was an average of 50 or 60 brilliant flashes to the minute. The electricity supply at Isleworth and West Ham failed for a time in certain quarters and, according to *The Times*, while the telegraph and radio services were unaffected, both working quite smoothly throughout the storm, the telephonic service suffered severely. In the London area on July 10th, three thousand subscribers' lines, out of a total of 202,000, were reported to be out of order. The southern district was the most affected—1,112 of the lines were in that area, a large proportion of these being in Kingston and Richmond. In the north-eastern district the number was 774 and in the north-western district 710. "Out of order" does not necessarily mean that the line is down; in many cases lightning had blown the fuses.

The trouble was widespread, 150 junction lines being out of order and 126 trunk lines, out of a total of seven hundred. Four of the eleven Paris lines were down, as also were one line to Amsterdam and one to Rotterdam—a total of six down out of twenty-three Continental lines. In each of these cases the damage was on the Continent, the circuits in this country being underground and unaffected by the heavy rain, which proved the most severe test they have had. In London by evening it was reported that the majority of the lines had been repaired.

The *Daily Mail* reports that a tramway car was struck by lightning and set on fire on the Victoria Embankment, London, and that the Tees-side railless tramway service was suspended for about three hours on July 10th owing to lightning striking the power house. The London fire brigade had 17 false alarms due to lightning interfering with the instruments. The Post Office radio-telegraph station transmitted messages during the worst part of the storm to Nova Scotia, where they were received without interference, but the British Broadcasting Co.'s concert from 2LO was, towards the end, entirely spoiled by atmospherics.

High-Pressure Boiler Plant.—The *Electrical World* states that an experimental 1,200 lb. per sq. in. boiler-plant is to be installed at the Calumet station of the Commonwealth Edison Co., Chicago. The equipment is being designed by the Babcock & Wilcox Co., in conjunction with the consulting engineers of the Commonwealth Edison Co. The boiler unit will be of the inclined header cross-drum type, and will comprise a lower deck of 2-in. tubes in sections eight high, having a setting height of 25.8 ft., primary and secondary superheaters in an inter-deck space, an upper deck of seventeen-high sections of 2-in. tubes, horizontal 3½-in. circulating tubes entering a 48-in. cross drum, and a Babcock & Wilcox steel contraflow economiser. The complete unit will be about 28 ft. wide and 36.5 ft. deep, including the economiser, and 45 ft. above the floor. The heating surfaces will be approximately as follows: Boiler, 15,750 sq. ft.; primary superheater, 2,120 sq. ft.; secondary superheater, 3,300 sq. ft.; and economiser, 9,230 sq. ft. The headers will have 1½ in. thickness front and back and ⅝ in. sides, and they are designed to give the tubes a stagger of about 4 in.

The cross drum is to be a forged steel cylinder 48 in. in diameter and 4 in. thick, with integral drumheads, each with a manhole closed by a 12-in. by 16-in. manhole fitting. In order that the holes for connecting the circulating tubes to the drum may have the largest practicable ligaments between circumferential rows of holes an unusual arrangement of connections has been adopted. At the top of each header two horizontal circulators will be connected, but the circulators for each alternate header will be bent downward and sideways, so that they will be connected to the drum in the same circumferential row as the circulators without such bends. This will make the distance between these circumferential rows about 16 in. In the same way the downtake nipples will not be straight but bent, so that two downtake headers will be connected to each of these circumferential rows of holes in the drum. The primary superheater will have 8-in. headers drilled for three staggered rows of tube holes, with 72 tubes in each row. It is designed to raise the temperature of the steam under 1,200 lb. pressure to 750 deg. The secondary superheater has 11¾-in. headers drilled for four staggered rows of 72 tubes each. This secondary superheater encloses the primary superheater and is intended to raise the temperature of the exhaust from the e.h.p. turbine to 750 deg. The economiser will have 44 rows of tubes.

The boilers for the Crawford Avenue plant will be of the Babcock & Wilcox high-pressure design, but will be built for a maximum working pressure of 650 lb. per sq. in. For each set there will be five boilers, each with about 15,600 sq. ft. of steam-making surface, except that one boiler on each set will be of special design and equipped with an interstage superheater.

The Crawford Avenue station is designed for an ultimate rating of 500,000 kW or, possibly, 600,000 kW.

The Structure of the Atom.—The issue of *Nature* for July 7th contains a special 16-page supplement in which Prof. Niels Bohr, professor of physics in the University of Copenhagen, gives a comprehensive and striking account of the present state of knowledge of the structure of the atom.

Prof. Bohr has taken a leading part in the development of modern conceptions of atomic structure, and he devotes particular attention in his paper to the interpretation of spectra, and the main features of the properties of atomical elements on considerations of the manner in which an atom can be imagined to be built up by the capture and binding of electrons to the nucleus, one by one.

The Endowment of Research.—The Council of the Royal Society has considered the best method of using Sir Alfred Yarrow's gift of £100,000, and has decided to devote the bulk of the income to the direct endowment of research, by establishing a number of professorships, the holders of which will be expected to make scientific research their main occupation, though they may devote a limited time to the instruction of advanced students.

Educational.—MANCHESTER COLLEGE OF TECHNOLOGY.—On July 5th, the coming-of-age of the College was celebrated by a luncheon at the Town Hall at the invitation of the Lord Mayor, at which Lord Burnham was the principal guest. In the evening a conversazione was held in the College, the guests numbering over 2,000; numerous exhibits and demonstrations were arranged in the various departments.

This Week's Story.—A letter received from the "Exide" Service Station in Johannesburg, which reads as follows, suggests a new relationship between electricity and agriculture:—

"A farmer recently brought a 'Ford' car to the 'Exide' station here, as the battery would not start the engine; or as he put it, the car would not start. He was unaware of the presence of a battery on the car, and had, therefore, never added any water.

"On examination, it was found that there was a layer of mud on the top of the battery, reaching up to the floor boards. Into this mud grain had fallen at one time and another, with the result that all round the mud it had grown and was shooting out blades about 4 in. long. The battery was absolutely dry, but would still turn the motor over, but not fast enough to start the engine. It was filled up with water, and without any additional charging, started the engine at once."

The 3-wire d.c. System.—At the last Council meeting of the Electrical Contractors' Association (Inc.), the following resolution was passed:—"That it is, in the opinion of this Association, a dangerous practice to install the two sides of a 3-wire d.c. system in one room in a private house or office where portable apparatus is used, and that for the protection of the public the practice should be discontinued. This Association is anxious to do all that is possible to develop the use of electricity for domestic purposes and to make it safe for the public, and submits for consideration that the balancing of one house or flat against another will give a far more effective balance than the manner now adopted by some supply authorities."

Appointments Vacant.—Mains superintendent, for Blackburn Corporation electricity department (N.J.B. Schedule, Class F, Grade 3); commercial assistant, for the West Gloucestershire Power Co., Ltd. (See our advertisement pages to-day.)

Safety in Mines.—The President of the Institution of Mining Engineers has received a letter from the Mines Department giving particulars of coal-dust explosion demonstrations which are to take place at Eskmeals Experimental Station, Cumberland, on every Sunday from July 15th to September 30th inclusive.

Legal.—CORRECTION.—In our last issue, in a report of the action Accumulators of Woking, Ltd., *v.* Higgins, Ltd., we erroneously stated that Mr. Exley was called as a witness for the defence. Mr. Exley informs us that the reverse was the case; he gave evidence on behalf of the plaintiffs.

Edinburgh Electricity Supply.—OPENING OF PORTOBELLO STATION.—On Wednesday last the electricity supply station at Westbank, Portobello, was formally opened by the King. His Majesty was accompanied by the Queen and the Duke and Duchess of York. The occasion was of exceptional interest in that this was the first of the new super-stations to be opened by the King in person, and it was a compliment to electrical engineering, as this was the only public function which their Majesties had agreed to take part during their stay in Edinburgh.

Lord Provost Sir Thomas Hutchison and Lady Hutchison received the Royal party at the door of the station, and the Lord Provost presented the King with a gold key. His Majesty spoke of the pleasure which it gave him to perform this opening ceremony, and of his interest in the great scheme for the abundant supply of electricity. Thereafter the Royal party was conducted over the station by Sir Alexander Kennedy, the consulting engineer, and Mr. F. A. Newington, electrical engineer to the City of Edinburgh.

The Control of London Traffic.—At a recent meeting of London Unionist M.P.'s, Col. Wilfrid Ashley, Parliamentary Secretary to the Ministry of Transport, and General Maybury outlined a scheme drawn up by the Ministry, which will be embodied in a Bill to be introduced during the autumn session to deal with the congestion of London traffic. Many of the recommendations of the Ullswater Commission and the Kennedy-Jones Select Committee have been followed in the preparation of the scheme. The principal point is that the Ministry of Transport will be constituted the traffic authority for the area covered by a circle of 25 miles' radius from Charing Cross. It will be assisted by a Statutory Advisory Committee, on which the following authorities and organisations will have representation:—The Ministry of Transport; the Home Office; the London County Council; the City Corporation; metropolitan boroughs; the six County Councils affected; other municipal authorities in the area; transport workers' organisations; the London "Underground" combine; the railway companies; and commercial vehicle users.

INSTITUTION NOTES.

Institute of Metals.—The annual autumn meeting of the Institute of Metals will be held from September 10th to 13th, and it promises to be an exceptionally interesting gathering. The meeting will open with the second annual autumn lecture, to be delivered by Lieut.-Col. Sir Henry Fowler, K.B.E., on "The Use of Non-Ferrous Metals in Engineering." The lecture will be a popular one, and is open to the public, tickets being obtainable from Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, S.W.1. With the exception of the autumn lecture, the meetings are open only to members and students of the Institute.

The Society of Engineers (Inc.).—The accounts for the year 1922 show total income £1,114, expenditure £1,075, leaving a surplus of £39, carried to the accumulated fund account.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. AUSTIN FIELD, transport manager to the Yorkshire Electric Power Co., fell from his motor-cycle in Ravensthorpe on Friday last, and was removed to the Dewsbury Infirmary in a serious condition.

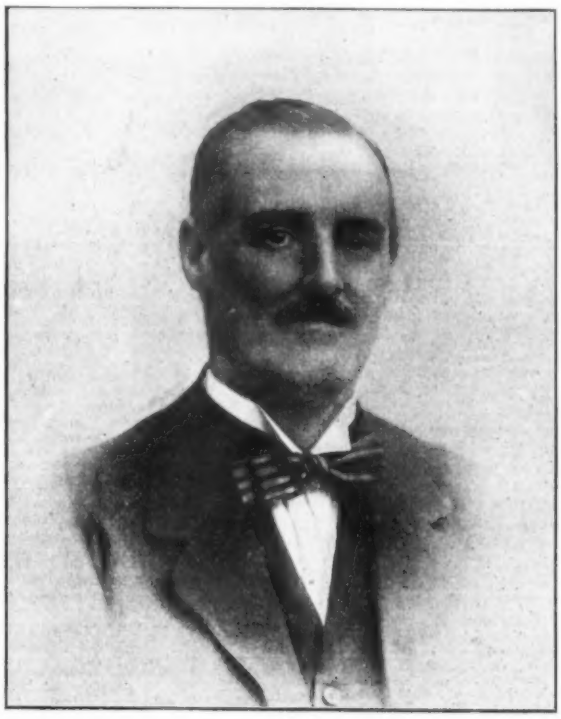
Mr. VICTOR DELEBECQUE informs us that the agreement between the Electrical Apparatus Co., Ltd., and himself has been mutually terminated, and that all correspondence in future should be addressed to him at Cedar Court, No. 1, 18, Cedars Road, Clapham, S.W.4.

Sir TOM CALLENDER (the well-known head of Callender's Cable & Construction Co., Ltd.) was recently entertained to dinner, and presented with a souvenir of Glasgow, by the members of the Glasgow Welfare Association, to which last year he presented a trophy for the annual football competition. Sir Tom is an old Glasgow boy; he was born in Patrick, once a suburban burgh of the great city. A happy evening was spent, and Sir Tom gave some interesting reminiscences of his early days in Glasgow and his travels round about. Dr. Dewar and Councillor McInnes Shaw, representing the Electricity Committee, both of whom are interested in the Welfare Movement, were present, along with Bailie Izett, who represented the Cleansing Department, the winners of the Callender Trophy for this season.

Mr. PARRETT, for the past 21 years manager of the Heckmondwike District Council's electricity works, and his wife, celebrated their silver wedding anniversary on July 2nd by a gathering held at the Co-operative Café.

Our correspondent reports that the Ilkley District Council has, by a majority vote, asked its electrical engineer, Mr. JOHN SENIOR, to resign. The chairman of the Electricity Committee (Mr. W. B. Dornan), at the meeting last week, said the Council had known for a long period that it would be necessary to purchase electricity in bulk instead of continuing to produce it by the present plant, and the Commissioners had ruled that further extensions to the plant were out of the question. Negotiations were therefore in progress with the Yorkshire Electric Power Co. Several weeks ago the engineer had been asked to prepare a scheme for this conversion. He had prepared a report which, according to the chairman, was no real scheme, and up to a few days prior to the meeting there was no scheme in evidence. The Committee then decided to ask Mr. Senior to resign, but a day or two later Mr. Senior told the chairman he had been busy preparing a specification. Mr. F. Shackleton, seconding, said it was well known that they would probably require an additional supply for the coming winter, yet it was now July, and there was no scheme forthcoming. He considered Mr. Senior ought to have prepared specifications which could have been taken to an engineer and prices asked for. An amendment that the minute of the Committee be referred back for further consideration was defeated, and the decision to ask for resignation carried.

As was announced at the annual meeting of the Electrical Contractors' Association, Inc., and was recorded in the ELECTRICAL REVIEW for June 29th (p. 1038), Mr. R. E. ROBSON has consented to act as president of the Association for the ensuing year. He follows Mr. H. Marryat who, as our readers will have gathered, has had a very busy period in office rendering important services in connection with the development of the E.C.A. and its associated organisations. Mr. Robson, whose photograph we publish herewith, was born in 1877, so that he is in the years when, if youthfulness counts, he may accomplish much, especially when it is taken into account that he has had many years' practical experience in electrical work. He has been a member of the Newcastle Branch of the E.C.A. since the year 1900; he was the first secretary, indeed practically the founder of the branch. He has been secretary of the Northern Section since 1906 and a member of the Council for over 15 years, so that, if anybody knows the problems that have faced and are now confronting electrical contracting interests that person is the new president. Mr. Robson is an Associate Member of the I.E.E., a member of the Engineers' Club, and as a true Northumbrian born in Newcastle he resides at Gosforth. If he can be said to have any hobbies they are the game of



James Bacon & Son] *[Newcastle.*

MR. R. E. ROBSON, THE NEW PRESIDENT OF THE ELECTRICAL CONTRACTORS' ASSOCIATION, INC.

"Eca" and motoring. For indulgence in the former he will have abundant opportunity as he follows up the new trading scheme that is now occupying the minds of so many contracting and other men, and, with regard to the latter, the interests of the E.C.A. will doubtless require Mr. Robson to travel to and fro so frequently that he will be tempted to exceed the speed limit many a time during 1923 and 1924. As to the ground work upon which Mr. Robson has built up his career, it should be stated that he was educated at Newcastle Modern School and at Armstrong College, Newcastle. His apprenticeship was served in part with Messrs. J. and G. Joicey, engineers, of Newcastle, and it was completed with Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne. He started in business on his own account in 1898, and went into partnership with Mr. Coleman about the year 1904. That partnership was dissolved in 1911, since which year Mr. Robson has been in business alone as R. E. Robson, electrical engineer, Electricity House, Haymarket, Newcastle-on-Tyne. The new president has the best wishes of the ELECTRICAL REVIEW for a successful year advancing the interests of the electrical industry in general and those of the electrical contractors in particular.

There were over 50 applications for the position of general manager to the Salford Corporation Tramways. The Committee selected eight to appear before it last week. At a meeting of the Tramway Committee on Tuesday, Mr. J. S. DUNCAN MOFFET was unanimously selected for the appointment. Since 1916 he has been manager of the Belfast city tramways.

Obituary.—COUNCILLOR R. WAINE.—We regret to learn that Councillor R. Waine, chairman of the Tynemouth Electricity Committee, passed away suddenly last week. Mr. Waine, who had recently retired from business, attended the I.M.E.A. Convention at Scarborough, when he appeared to be in his usual health. While there he was seized with an attack of heart trouble, and on returning home he became steadily worse, passing away on the 4th inst.

Mr. C. S. MEIK.—The death occurred on Thursday last week of Mr. Charles Scott Meik, M.Inst.C.E., at the age of 70 years. He was to have read a paper at the International Congress on "Navigation" on Friday last; he prepared the paper while in bed after a serious operation. *The Times*, in referring to his work, says that he had prepared for the Congress a summary of a series of reports from various countries on the question of utilising the tides for the production of power at docks for such purposes as lighting and the working of lock-gates. Jointly with Mr. G. L. Addenbrooke and Mr. J. W. Twinberrow he was also the author of a paper contributed to the congress on the production of power from the Severn estuary, a subject to which he had devoted much attention.

Mr. A. TOBLER.—*The Times* records a report from Zurich of the death of Mr. A. Tobler, aged 70, professor of electricity and telegraphy at the Federal Polytechnic High School.

Mr. J. C. SMITH.—The death is reported of Mr. John Charles Smith, late accountant of the Anglo-American Telegraph Co., Ltd.

Herr J. P. RINGSDORFF.—The death is announced from Mehlen-am-Rhein, Germany, of Herr J. P. Ringsdorff, principal of the Ringsdorff works (carbon brushes and brush-holders) in that town.

NEW COMPANIES REGISTERED.

M. E. L., Ltd. (191,047).—Registered as a private company on July 2nd with a nominal capital of £35,000 in £1 shares (11,000 10 per cent. cumulative preferred participating and 24,000 ordinary). Objects:—To acquire from the liquidators of Phi-Kappa Syndicate, Ltd. (1) Sundry letters patent and provisional protections for improvements in a variety of electrical utensils; (2) plant, machinery, and tools; (3) stock-in-trade; (4) fixtures, office furniture, shop patterns, working drawings, and all loose chattels; (5) works at 47, King's Road, St. Pancras, N.W.; and (6) the goodwill of the business and all other assets and effects, except interest in the Olsen engine, and to carry on the business of ironfounders, mechanical and electrical engineers, motor and motor-car and cycle manufacturers, &c. The first directors are:—Sir Alexander King, Kt., 50, Wood Vale, Sydenham, S.E. (director of West India and Panama Telegraph Co., Ltd.); W. Rogers, The Court Lodge, Horton Kirby, Kent (director of Rumpelmayer, Ltd.); E. D. Pearcy, 44, Finchley Road, N.W.; E. J. V. Earle, "The Chestnuts," Denmark Hill, S.E. (director of Olsen Engine Syndicate, Ltd., Stereo Kinema Syndicate, Ltd., and London and New York Contracts, Ltd.); T. W. Goulding, 30, The Avenue, Brondesbury Park, N.W. (director of West India and Panama Telegraph Co., Ltd., Olsen Engine Syndicate, Ltd., Stereo Kinema Syndicate, Ltd., and London and New York Contracts, Ltd.). The said E. J. V. Earle and T. W. Goulding shall be the first managing directors and shall receive £600 each per annum as remuneration, in addition to their fees as directors. The registered office is at 2, Staple Inn, W.C.1.

Harrison & Searle, Ltd. (190,983).—Private company. Registered June 28th. Capital, £1,000 in £1 shares (600 ordinary and 400 7 per cent. cumulative preference). To carry on at 13, Gothic Arcade, Snow Hill, Birmingham, and elsewhere, the business of an electric light company in all its branches. The first directors are:—C. A. Harrison, 96, Bromyard Road, Hall Green, Birmingham; M. W. Searle, 724, Coventry Road, Small Heath, Birmingham. Registered office: 13, Gothic Arcade, Snow Hill, Birmingham.

Foster & Foster, Ltd. (191,040).—Private company. Registered July 2nd. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, electrical sign makers, stampers, piercers, welders, &c. The first directors are:—A. B. Foster, 9, Francis Road, Edgbaston, Birmingham, electrical engineer; E. Gilbert, 70, Thornhill Road, Handsworth, Birmingham, auctioneer (managing director). Qualification, 100 shares. Registered office: 85, New Street, Birmingham.

Skegness Electricity Supply Co., Ltd. (191,147).—Private company. Registered July 5th. Capital, £1,000 in £1 shares. To carry on business as indicated by the title. The first directors are:—S. J. W. Scott, 3, Selsden Road, West Norwood, S.E.27; G. V. Russell, 111, Fernhead Road, Maida Vale, W.9; F. Wall, "Chetwynd," Grays, Essex; A. N. Hardie, "Bandoola," Hollypark Gardens, Finchley, N.3. Qualification, £1. Secretary: A. N. Hardie. Registered office: 1-2, Rupert Court, Rupert Street, W.1.

Uni-Directional Apparatus Co., Ltd. (191,139).—Private company. Registered July 5th. Capital, £5,000 in 4,000 7 per cent. cumulative preference shares of £1 each and 20,000 ordinary shares of 1s. each. To adopt an agreement with Aaron Barnett to acquire the patent No. 17,888 of 1922, and to carry on the business of electricians and manufacturers of, and dealers in apparatus used in connection with the generation, distribution, supply, accumulation, and employment of electricity, manufacturers and repairers of, and dealers in motor-cars, cycles, &c. The first directors are:—Aaron Barnett, 269, Mile End Road, E.1; S. T. Whiteman, Park Hill House, Carshalton, Surrey; J. B. Crockett, 14-16, Cockspur Street, S.W.1 (director of E.D. Motors, Ltd.); F. W. Poynor, 14-16, Cockspur Street, S.W.1; E. W. Hopping, 14-16, Cockspur Street, S.W.1. The said Aaron Barnett shall be permanent, subject to holding 3,500 ordinary shares. Qualification of other directors, 1,000 shares. Registered office: 14-16, Cockspur Street, S.W.1.

W. E. C., Ltd. (190,910).—Private company. Registered June 25th. Capital, £200 in 1,000 ordinary shares of 1s. each and 150 10 per cent. cumulative preference shares of £1 each. To carry on the business of manufacturers of and dealers in all types of complete instruments and accessories connected with telephony, telegraphy, and wireless telephony and telegraphy, &c. The subscribers (each with 325 ordinary shares) are:—H. E. Wiltshire, 41, Tressillian Road, St. John's, S.E.4, accountant; J. R. S. Eley, 283, Brownhill Road, Catford, S.E.6, sales manager. H. E. Wiltshire is the first managing director. Remuneration as fixed by the company. Registered office: Room 91, Gloucester House, Charing Cross Road, W.C.

G. Davenport (Wireless), Ltd. (191,088).—Private company. Registered July 3rd. Capital, £10,000 in 9,750 ordinary shares of £1 and 5,000 deferred shares of 1s. To take over the wireless part of the business of G. Davenport & Co., Ltd., and certain of the assets thereof. The first directors are:—G. Davenport, 59, Elderton Road, Westcliff-on-Sea, managing director (director, G. Davenport & Co., Ltd., and J. A. Coomes and Co., Ltd.); I. Henderson, D.Sc., M.I.E.E., "Kinnoull," Beaconsfield, Bucks., chairman (director, G. A. Coomes & Co., Ltd., and Charles Orme and Co., Ltd.). G. Davenport & Co., Ltd., may, during the continuance of the agency agreement, while the said G. Davenport is a director, nominate one director, and after the said G. Davenport ceases to hold office, they may nominate not more than two directors. Registered office: 10 3-5, Clerkenwell Road, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

F. W. Lamp Co., Ltd.—Debenture dated June 25th, 1923, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. J. M. L. Agazarian, "Bramble Haw," Carshalton, Surrey.

Westminster Tool and Electric Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital (but so far as relates to freehold property, subject to a mortgage for £4,500 thereon) dated June 22nd, 1923, to secure £4,500. Holder: Rev. W. P. Michell, 66, Pembroke Road, Clifton, Bristol.

Torpoint Electric Supply Co., Ltd.—Satisfaction in full on February 15th, 1923, of debenture dated January 17th, 1916, securing £2,500. (Notice filed June 29th.)

Hydro-Electric Power and Public Services Trust. Ltd.—(121,598).—Return dated December 31st, 1922 (filed February 1st, 1923). Capital, £500,000 in £5 shares. Seven shares taken up. £35 paid. Mortgages and charges, nil.

George Hill & Co., Ltd. (111,526).—Return dated January 28th, 1923. Capital, £4,000 in £1 shares. 2,150 shares taken up. £2,150 considered as paid. Mortgages and charges, nil.

International Dowsing Electric Heating and Appliances Co., Ltd. (83,693).—Return dated December 31st, 1922 (filed April 25th, 1923). Capital, £20,000 in £1 shares. 18,107 shares taken up. Nil called up on 7 shares. £18,100 considered as paid on 18,100 shares. Mortgages and charges, nil.

British Electrical Export Co., Ltd. (138,028).—Return dated May 31st, 1922 (filed March 12th, 1923). Capital, £2,000 in £1 shares. 103 shares taken up. £103 paid. Mortgages and charges, nil.

Llangefni Electric Light and Power Co., Ltd. (111,909).—Return dated April 5th, 1922 (filed June 21st, 1923). Capital, £3,000 in 2,750 preference and 250 ordinary shares of £1 each. 2,566 preference and 250 ordinary shares taken up. £2,566 paid on the preference shares. £250 considered as paid on the ordinary. Mortgages and charges, £2,400.

Durham and District Electric Traction Co., Ltd. (79,285).—Return dated May 8th, 1923. Capital, £30,000 in £1 shares. Seven shares taken up. £7 paid. Mortgages and charges, nil.

Douglas Southern Electric Tramways, Ltd. (45,701).—Return dated January 4th, 1923. Capital, £50,000 in 30,000 preference and 20,000 ordinary shares of £1 each. 25,973 preference and 15,472 ordinary shares taken up. £18,370 paid on 12,566 preference and 5,804 ordinary shares. £23,075 considered as paid on 13,047 preference and 9,668 ordinary shares. Mortgages and charges, £1,376 13s. 6d.

Credenda Conduits Co., Ltd. (126,340).—Return dated January 12th, 1923. Capital, £50,000 in £1 shares. All shares taken up. £30,000 paid. £20,000 considered as paid. Mortgages and charges, nil.

CITY NOTES.

Oriental Telephone and Electric Co., Ltd.

The annual meeting was held on July 3rd; Sir H. Babington Smith, G.B.E. (the chairman), presided. The Chairman said that the gross income from subscriptions, rentals, profits on sales of material, &c., was £131,485, as against £118,508 last year. There had been an increase at each of the branches, Madras, Rangoon, Moulmein, Mauritius and Singapore, the largest increase being at Singapore, where the gross revenue increased from £49,367 to £58,577. Against the increase of about £13,000 in the gross revenue, they had to set an increase of about £9,500 in the expenditure for maintenance, depreciation, and renewal of plant. This increase arose, in part, from the growth of the system, and, in part, from special causes of a temporary character. Investments in subsidiary companies had produced nearly the same revenue as last year, the sum being £23,428, as compared with £24,905. The dividend received from the Bengal company represented six months only, owing to a change in the date of the termination of the company's year. The Bombay company had not yet declared its dividend, but it had been assumed provisionally that the dividend would be at the same rate as last year, *i.e.*, 14 per cent. If the dividend should be at some different rate, an adjustment would, of course, be necessary. There had during the past year been a rather heavy depreciation of the stock in hand at Mauritius, due principally to the general drop in prices since part of the stock was purchased, resulting in a loss of £7,568, which had been charged to the depreciation and general reserve account. There had been a substantial reduction in income tax, and, on the income side, there was no longer an item for surplus on realisation of sundry investments, which last year produced £5,297. The net result was that the balance of revenue credited to the balance sheet was £49,010, as against £49,227 last year. The number of exchange lines in the systems worked by the company and subsidiary companies was, in December, 1921, 35,000. It was on December 31st, 1922, 37,513, an increase of 2,513, being at the rate of 7 per cent. for the year. This rate of progress was not so rapid as it had been, but there were several causes to account for this result. Business conditions had been unfavourable, and the telephone service was a good index of the prevailing business prosperity, or the reverse. In some of the places with which they were concerned there had been difficulty in providing telephone services for all applicants, owing to temporary insufficiency of plant; steps had been taken to remedy this. The Chairman then went on to deal with the subsidiary companies *seriatim*. Last year, he said, he referred to the question of the Indian licences and also to the negotiations

regarding the company's licences at Hong Kong and Singapore. In India, agreements between the Bombay and Bengal companies and the Indian Government had been signed, and also agreements relating to Madras and Rangoon. A new local company had been formed at Madras, and in Rangoon a similar course was being pursued. The principal points in the conditions of the new agreements were that they had now obtained an undisturbed tenure for 20 years, and had undertaken certain obligations to provide thoroughly efficient and modern plant; they had increased maximum rates with periodical revision on the basis of a standard dividend of 12½ per cent. on the paid-up capital, of which 8 per cent. was cumulative, after due allowance for depreciation and reserve. The Bombay and Bengal companies had been reorganised. The Bombay Telephone Co. was taking steps to provide automatic equipment at its principal exchange at Bombay. Although these demands would be met by the local company, it would still be necessary for the Oriental Company to bear a large part of the burden, and for the purpose an increase in the capital of the company, both in preference and ordinary shares, was necessary. They proposed to increase the authorised ordinary share capital from 300,000 to 600,000 shares of £1 and the preference shares from 100,000 to 300,000 shares of £1 each. As the preferential shareholders were asked to assent to this, it was thought that they should have some increase in the rate of interest, and it was proposed that the rate should be increased from 6 per cent. to 7 per cent. This improvement in the rate would also greatly facilitate the issue of new preference shares. The Chairman concluded by referring to the company's indebtedness to the staff at home and abroad, and particularly the latter on account of the more trying conditions under which they worked. The sum of £2,000 was voted to Mr. G. Parker Ness for his services in India, and the question of further remuneration was left to be decided at the next meeting.

An extraordinary general meeting followed, and a resolution was carried increasing the cumulative preference dividend from 6 to 7 per cent. per annum, and varying the articles of association accordingly.

Crompton and Co., Ltd.

The annual meeting was held on July 5th at Winchester House, E.C. Mr. A. A. Campbell Swinton, F.R.S., presided, and in proposing the adoption of the report he said the item of freehold land and premises, plant, tools and other assets, less depreciation, stood in the balance sheet at £91,872, a reduction of £27,000 as compared with a year ago. Certain expenditure had been incurred during the year on additional plant and tools, but that had been more than set off by depreciation written off and by realisation of some of the other assets included in that item. Stock and work in progress showed a reduction on last year's figures of £12,000 odd. Sundry debtors showed a reduction of £17,000, and investments were reduced from £13,900 to £7,600. Cash at bankers and in office was increased by about £2,000. The loan to the Chelmsford Corporation which appeared last time —£9,771—had since been repaid. Turning to the other side of the account, the first mortgage debentures were reduced by £7,600. The reserve fund, which was undivided profits, stood at £750,000, as before. The loan from the bankers, which stood at £30,000 in the last account, had been paid off. Sundry creditors and bills payable, including reserves for taxation, showed an increase of £10,000. Coming to the profit and loss account, during the first six months of the financial year—to September 30th, 1922—they were very short of work in the factory, with the result that the gross profits earned were not sufficient to meet the expenses and a substantial loss was incurred. At the commencement of the second half of the year a distinct improvement was experienced and they were in hopes that the profits of the remaining six months were going to be good enough to wipe out the loss of the first half of the year and leave them with a respectable balance, but the promise of an improvement in trade was not fulfilled. In consequence the profit which they made in the second half of the year was not sufficient to wipe out the first six months' loss. The reduction in wages which took place in the financial year was naturally followed by a corresponding fall in prices, which necessitated the writing down of the stocks of finished and partly-manufactured goods, both at their works and abroad by over £35,000, and that notwithstanding the fact that their stocks were conservatively valued in April, 1922. Practically all their standard machines were manufactured in quantity—that was the only economical method and the only method by which quick deliveries could be given. All such stock had been written down to replacement value. It might interest the shareholders to know that out of the gross profits earned by the company on trading during the last two years they had provided a sum of approximately £98,000 to cover depreciation in their various assets and obsolescence, and in the year ended March 31st, 1921, the amount provided for the same purpose was not far short of £100,000; therefore, in three years they had provided nearly £198,000 for obsolescence and depreciation. As to the future, while he did not think they could look forward to a substantial and permanent improvement in trade until the political conditions upon the Continent were more or less straightened out, it was satisfactory to be able to state that the unexecuted orders at the end of their financial year were well in advance of the figure at the commencement, and that notwithstanding the very considerable fall in prices. Since the close of the accounts, and more particularly during the last few weeks, orders had come in in a much more satisfactory way. At the last meeting he expressed a hope that when they met that day he would be able to give them a more encouraging and hopeful forecast of the business. That hope was fulfilled in part. He did not wish the shareholders to imagine that the outlook for business was all that they could hope for, but the anxiety with regard to the immediate future that was present in his mind at the last meeting was, to a large extent, removed, and with the prospect of business which they saw before them he felt inclined to say that they had passed the worst part of the post-war period. With the decrease in the cost of living the directors decided that a general reduction in salaries should be made, and as they were asking the staff to agree to a reduction they felt it was only right that they should set them a good example by making a like reduction in their own fees.

Mr. C. F. Tufnell seconded the motion, which was unanimously agreed to.

Automatic Telephone Manufacturing Co., Ltd.

Sir Alexander Roger (chairman) presided at the annual meeting on July 2nd. In presenting the report and accounts, which were reviewed in our issue of June 8th (p. 908), he said the results were substantially better, and showed that a return of normal conditions would ensure an improvement of the earning capacity of the company. The profits and allocations to depreciation, &c., would have to be higher before it would be safe to pay a dividend on the ordinary shares. Dealing with the balance sheet he said that the item "sundry creditors" had been reduced from £132,998 to £97,618. This was not so satisfactory as it appeared, as the reduction was mainly due to a falling-off in the amount of material purchased toward the end of the year and to the re-payment of temporary loans. Owing to careful control of raw material purchases, combined with a decline in market values, and completion of orders at the date of the balance sheet, the item "stock-in-trade and work in progress" was lower by £63,087. Sundry debtors were £50,000 up consequent upon heavy shipments made at the close of the year; payments against these were coming in satisfactorily. Very substantial automatic telephone orders had been executed for foreign clients during the year. A contract for 11,000 exchange lines was received from Bombay. The major portion of the equipment was completed and shipped at the end of December, and the work of erection was now being directed by the company's own engineers. The Dalny (Manchuria) 6,000-line equipment was put into service on March 31st last, the contract date. This was an excellent achievement having regard to the unusual circumstances. Important work had also been executed for South American clients, and the foreign business generally was steadily developing.

In this country several orders had been received from the Post Office for the conversion of manual equipment to automatic working, and other orders had been placed for exchanges in rural areas. Among the private orders secured were one for a 700-line exchange at the new London County Hall, and one for 500 lines at the London, Midland & Scottish Railway's depôts at Manchester and Derby.

The company and its Chicago associate were the inventors of the Strowger system, and to-day out of 1,000,000 automatic telephones in use 90 per cent. were on the Strowger system.

Although it had drawn upon American technical knowledge and experience, the company was in no way dependent upon America for engineering or manufacturing. The works at Liverpool was capable of producing the most complex automatic telephone plant. The automatic telephone business in this country had been retarded by the war, but he (the speaker) wished to place on record that they had always found the Post Office receptive to new ideas, and several important developments had been carried out by it in co-operation with the company.

Good business had been done in mine signalling apparatus and domestic heating and cooking appliances, and the range of wireless apparatus produced to meet the demand for this equipment had met with great success. Trading prospects appeared brighter than they did a year ago, and contracts for which they were negotiating might possibly bring a considerable volume of business to the factory. The directors of the International Automatic Telephone Co., Ltd., had decided to re-open the offer of the exchange of holdings in that company for the Automatic Company's shares, for the benefit of new shareholders.

British Empire Trust Co., Ltd.

At the annual meeting on July 2nd, the deputy-chairman (Mr. J. Davidson) said that the most important financial business which had been undertaken during the year was the financing of a power station and distribution system in West Gloucestershire, to serve an area of 300 square miles, including the Forest of Dean coalfield, and the Stroud Valley industrial district. Turning to the other companies with which they were connected, he said that negotiations with the Vancouver City Council had resulted in placing the question of fare revisions on a sound basis. By the new arrangements the British Columbia Electric Railway Co. secured the establishment for three years, from November 8th, 1922,

of the 6-cent fare. At the end of this period mutual agreement or arbitration would be resorted to for the further settlement of the question. As a result of this the company had been able to reduce its charges for domestic lighting from 6 to 5 cents per kWh. The revenue of the company, since the beginning of January, had shown a satisfactory improvement, the increases aggregating about $126,000 for the first five months of the year.

Since its re-organisation in 1921, the Monterey Railway Light & Power Co. had been able to pay regularly the interest on its 5 per cent. "A" first mortgage debenture stock. The company had not yet been able to arrive at a settlement with the Government of the State of Nuevo Leon in respect of the amounts due under State guarantees in connection with the water and sewage concessions. The settlement of this matter and improved political conditions in Mexico should give the company scope for satisfactory progress. The net earnings of the Winnipeg Electric Railway had been maintained in spite of industrial depression, by means of economies in working expenses.

Marconi International Marine Communication Co., Ltd.

The gross revenue for the year ended December 31st, 1922, was £1,103,971, as compared with £1,084,460 for 1921. The net profit was £171,848. This is an increase as compared with 1921, and is arrived at after writing off approximately £8,000 in respect of bad and doubtful debts. The increase is due in part to additional business consequent upon the return of ships to commission after the period of great depression in the shipping trade which necessitated the laying up of a large number of ships in 1921, and also to economies which have been effected throughout the organisation in the methods of working and control. The directors recommend a final dividend at the rate of 7½ per cent., which, together with the interim dividend, will make a total of 12½ per cent. for the year. During the year 63 debentures of a par value of £1,260 were redeemed. Meeting: July 13th.

London Underground Railway Companies.

The following dividend results are announced for the past half-year:—

Metropolitan District Railway Co.: On the 4 per cent. guaranteed stock of 2 per cent. On the 4½ per cent. first preference stock of 2¼ per cent. On the 5 per cent. second preference stock of 2½ per cent. On the ordinary stock of 1½ per cent. (comparing with 1½ per cent. for the same period of 1922).

London Electric Railway Co.: On the 4 per cent. preference stock of 2 per cent. On the ordinary shares of 2 per cent. (comparing with 1¾ per cent. for the same period of 1922).

City and South London Railway Co.: On the 5 per cent. preference stocks 1891, 1896, 1901 and 1903 of 2½ per cent. On the consolidated ordinary stock of 2 per cent. (comparing with 1¼ per cent. for the same period of 1922).

Central London Railway Co.: On the undivided ordinary stock of 2 per cent. (comparing with 2 per cent. for the same period of 1922). On the preferred ordinary stock of 2 per cent. (comparing with 2 per cent. for the same period of 1922).

Underground Electric Railways Co.: On the 6 per cent. first cumulative income debenture stock of 3 per cent. On the 6 per cent. income bonds of 3 per cent. (free of British income-tax), comparing with 2 per cent. for the same period of 1922.

Brazilian Traction, Light, and Power Co.

The revenue received in 1922 from subsidiary companies amounted to $7,422,897, and interest on investments, &c., to $450,064, making a total of $7,872,961. The net revenue, after charging legal and administrative expenses, interest and charges on secured gold notes and amortisation, was $6,851,968. From this were deducted four quarterly preference dividends at 1½ per cent. and two quarterly dividends at 1 per cent. on ordinary shares, leaving a surplus of $4,120,457, to which is added $5,719,813 brought forward, making $9,840,270. This has been distributed as follows:—To reserve, $3,000,000; carried forward, $6,840,270. During the year capital to the amount of $2,573,287 was expended. This does not include the expenditure upon the new plant of the Brazilian Hydro-Electric Co., Ltd. On November 1st, 1922, accumulated funds were employed to retire the issue of $7,500,000 secured gold notes made in 1916.

Cordoba Light, Power, and Traction Co.

The directors' report for the year ended March 31st, 1923, states that receipts, both gross and net, of electric lighting and power supply business and of tramways showed an increase over those of the previous year in spite of increased maintenance expenses and taxes. After providing for administration expenses, interest on debenture stock, loss on exchange and taxes, the profit was £73,291, plus £5,701 brought forward, making £78,992, less set aside for debenture stock redemption, £8,212. Dividends on 7 per cent. cumulative preference shares required £34,955, and there has been set aside for redemption of preference and ordinary share capital £5,000, and applied in writing down discount on and expenses of issue of 6 per cent. debenture stock, £25,000, leaving to be carried forward £5,825. An offer has been made for the acquisition by the company of the entire capital stocks of Argentine Tramways and Power Co. The debenture-holders of that company have agreed to accept the offer. At the meeting of the Cordoba Co. on July 16th, a resolution will be submitted increasing its capital from £1,750,000 to £2,200,000 by the creation of 450,000 additional shares of £1 each, 250,000 to be preference shares and 200,000 ordinary shares. It is proposed to change the name of the company to "The Argentine Light and Power Co., Ltd."

International Automatic Telephone Co., Ltd.

The annual meeting of the company was held in Liverpool on July 2nd, Sir Alexander Roger (chairman) presiding. The chairman said that the results were slightly better than those of 1921, but the profit was still insufficient to pay any dividend on the ordinary and deferred shares. The shares held in the Automatic Telephone Co., Ltd., stood at the same figure, £383,706. The item sundry debtors showed a substantial decrease owing to the settlement of some large accounts and to a falling-off in the value of goods invoiced at the end of the year. The item sundry creditors was also smaller. In conclusion, the speaker reviewed the results of the working of the Automatic Telephone Co., Ltd., whose annual meeting is also reported in this issue.

Italian Electrical Companies.

The *Società Piemonte Centrale di Elettricità*, of Turin (capital, 15,000,000 lire) has begun to feel the effects of the big programme of works completed in late years, and closed its accounts to December 31st last with an active balance of 787,807 lire, from which, after setting aside 300,000 lire to the sinking fund, a dividend of 8 per cent. was declared.

The *Società Elettrica Bergamasca*, of Bergamo (capital, 20,000,000 lire), has decided on carrying through the installation for the harnessing of the River Bremba from Lenna to Orbrombo, suspending meanwhile the plant projected on the Parnia. The accounts to December 31st showed an available balance of 1,019,897 lire, allowing of a dividend of 8 per cent.

The accounts of the *Società Idroelettrica del'Ossola*, of Milan, recorded a balance of 519,285 lire, from which a dividend of 10 per cent. was distributed on its 2,000,000 lire capital. The company has succeeded in creating a reserve for periods of drought by an arrangement with the Unione Esercizi Elettrici.

The results of the year's working of the *Società Anonima Elettrica Trevigiana*, of Treviso, enabled the distribution of a 9 per cent. dividend on its 8,000,000 lire capital.

The *Società Anonima Acquedotto de Ferrari Galliera* distributed 13.75 lire per share (capital, 12,000,000 lire).

The following 13 companies have declared dividends:—Società Boraficera di Lardarello, of Florence (capital, 7,000,000 lire), 10 lire per share; Società Anonima Elettricità Toscana, of Pisa (4,000,000 capital), 40 lire per share; Società Idroelettrica Val di Magra, of Spezia (300,000 lire capital), 1.8 per cent.; Società Laziale di Elettricità, of Rome (5,000,000 lire capital), 8 lire per share; Società Generale per la Illuminazione, of Naples, 5 per cent.; Società per Applicazioni di Energia Elettrica, of Torre Annunziata (3,000,000 lire capital), 1.8 per cent.; Società Forza & Luce, of Bari (1,930,000 lire capital), 8 per cent.; Società Barlettana di Elettricità, of Bari (capital, 1,000,000 lire), 2 lire per share; Società Anonima Industrie Elettriche Calabresi, of Radicena (3,000,000 lire capital), 4 lire per share; ;Società Forze Idrauliche dell'Appennino Centrale, of Pistora (4,000,000 capital), 9 lire per share; Società Trazione Elettrica Lombarda, of Milan (608,552 lire capital), 7.50 per cent.; Società Anonima Elettrochimica Ing Luigi Magrini (6,000,000 lire), 5 per cent.; Società Anonima Orobia, of Lecco (18,000,000 lire capital), 20 lire per share; and the Società Generale Elettrica della Sicilia (80,000,000 lire capital), 9 per cent.

The following increases of capital have been decided upon:—Società Idroelettrica Piemonte (Turin), from 80,000,000 to 100,000,000 lire; Società Idroelettrica dell'Ossola (Milan), from 20,000,000 to 30,000,000 lire; Società Mineraria ed Elettricità del Valdarno (Florence), from 50,000,000 to 80,000,000 lire; Società Generale Elettrica della Sicilia, from 50,000,000 to 80,000,000 lire; Società Anonima Elettrica Valle Versa (Milan), from 130,000 to 200,000 lire; Western Electric Italiana, from 2,500,000 to 5,000,000 lire; Società Trazione Elettrica Lombarda (Milan), from 8,000,000 to 10,000,000 lire; Società Anonima Impresa Elettrica Pollentina (Milan), from 300,000 to 500,000 lire; Società Piemonte Centrale di Elettricità (Turin), from 15,000,000 to 30,000,000 lire; Società Anonima Elettrochimica Ing. Luigi Magrini, from 6,000,000 to 10,000,000 lire; and the Società Anonima Idroelettrica Monviso, of Verzuolo, from 20,000,000 to 25,000,000 lire.

Prospectus.

The Hoffmann Manufacturing Co., Ltd.—This week there has been publicly offered for sale £400,000 6 per cent. first mortgage debenture stock at 98½ per cent. During the past year the company has purchased a half-share interest in the Norma Ball Bearing Co. of America, and the name of the Hoffmann Co. will in future be associated with the Norma Co. for the development of ball bearings, roller bearings, steel balls and steel rollers in the United States, and good results are anticipated from the close working association between the two companies. At the factory of the company at Chelmsford at present over 3,000 hands are employed. A note of the results for the past eleven years appeared in the prospectus. In 1920 there was a profit of £278,683, but in 1921 a loss of £97,706. This was followed by a profit of £68,227 for 1922. The average profits for the eleven years were £107,549.

Stock Exchange Notices.—Dealings in the following securities for cash or for account have been specially allowed by the Stock Exchange Committee under Rule 159:—

Lima Light, Power, and Tramways.—£1,500,000 6 per cent. first mortgage debentures, issued at 90 per cent., partly paid and fully paid.

The undermentioned securities have been ordered to be quoted in the Official List:—

Metropolitan District Railway Co.—£500,000 5 per cent. redeemable debenture stock, 1933-1953.

Metropolitan District and London Electric Railways.—£675,000 joint power bonds 4 per cent. rent charge stock.

United River Plate Telephone Co.—108,000 shares of £5 each, fully paid, Nos. 432,001 to 540,000.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—The profit for the year 1922 amounted to £7,568, as compared with £6,078 for the previous year. After providing £5,500 for depreciation, there remains a balance, including the amount brought forward, of £2,447 to the credit of profit and loss account. This will allow of the payment of 2 per cent., less tax, on the income debenture stock to be issued to holders of preference shares. The payment will be on account of the year 1922, and will be made as soon as the scheme now before the Court has been confirmed.

Brown, Boveri & Co.—As reported, the accounts of Brown, Boveri & Co., of Baden, Switzerland, show a surplus, after writing off 3,430,000 fr. for depreciation in 1922, as compared with 5,474,000 fr. in 1921, amounting to 715,000 fr., as contrasted with 1,082,000 fr. in the previous year. Having made the usual appropriation for bonuses, the directors propose to carry the balance forward, so that no distribution is made on the share capital, which was also the case for 1921.

Companies Struck off the Register.—The following companies have been struck off the register and are thereby dissolved:—

Dutih-Smith, McMullan & Co., Ltd.
Electric Furnaces & Smelters, Ltd.
Electropathic Institute, Ltd.
Superposed Currents, Ltd.

Drake and Gorham, Ltd.—According to the *Financial Times* the directors announce that, in addition to the redemption of half the £50,000 note issue which took place in May, they have now given notice to redeem further notes to the value of about £10,000, and the remaining noteholders have agreed to a reduction of interest from 10 to 7 per cent.

Consolidated Electrical Co., Ltd.—The directors state that the result of operations for the year to March 31st, 1923, coupled with depreciation in the company's investments, renders it advisable to defer payment of the half-year's preference dividend due July 1st.—*Financial Times.*

W. and T. Avery, Ltd.—In their report for the past year the directors recommend a balance dividend of 10 per cent., less tax, making 15 per cent. Carried forward £35,624.

Anglo-American Telegraph Co., Ltd.—Interim dividend for quarter ended June 30th of 15s. per cent. on ordinary stock and £1 10s. per cent. on preferred stock, less tax.

Midland Counties Electric Supply Co.—The 7½ per cent. mortgage debenture stock will be paid off at 102 per cent. on September 1st, 1923, with all accrued interest.

Greenwood and Batley, Ltd.—Dividend of 2½ per cent., making 5 per cent. for the year.

London Electric Wire Co. and Smiths, Ltd.—Interim dividend of 1¼ per cent., less tax, on the ordinary shares.

Telegraph Construction and Maintenance Co., Ltd.—Interim dividend of 6s. per share, free of tax.

Metropolitan Electric Supply Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum on the ordinary shares (6 per cent. last year).

STOCKS AND SHARES.

TUESDAY EVENING.

The Bank Rate has suddenly assumed the position of being the most important factor in the Stock Exchange, and a good many other financial circles. The rise to 4 per cent. last week came somewhat unexpectedly, and the difficulty of foreseeing what is happening in American finance gave cause for fears that a 5 per cent. rate might become necessary on the Thursday in this week. Consequently, the buying movement, which had previously lifted prices in all the investment stocks, came to a sudden halt, and gilt-edged stocks have been disposed to weaken a little, as one after another came to market when holders who view the monetary outlook with a certain degree of apprehension, and who are willing to take what, after all, are still good prices for the investment stocks.

The weakness in cable stocks continues to be one of the outstanding features amongst the electricity sections. There has been a trifling rally from the lowest prices touched, and the fall brought in a few bargain hunters who thought the drop had been overdone. Their purchases, however, have been so far on the modest scale, and there remain selling orders on behalf of people who have not got over the very latest scare in connection with "wireless." Therefore, Eastern ordinary is still quoted about 180, Globe preference are 5s. lower at 11⅛, and the remainder of the list shows no quotable recovery after the slump of last week. It is a little odd to notice that the wireless shares have already given way, Marconis being ⅛ lower at 2 3/16, and heaviness being observable in the shares of the associated concerns. Canadian Marconis drooped to 7s. 9d.

District stock has fallen below 50 again, and Metropolitans dropped to 66. The reason for the weakness is that the bulls bought a little more than was good for them, as the Stock Exchange says, in the earlier part of the year, and their disappointment at not seeing the prices continue to scar is reflected in selling that comes upon an unwilling market, there being little demand for speculative stocks at the moment. The Underground Electric issues are easier. Central Londons are unaffected by the general heaviness. Most of the prior-charge stocks, however, are lower, falls of a point or two occurring in debenture, preference, and rent-charge descriptions. Whereas it was exceedingly difficult a month or two ago to get the offer of such stocks at any price at all, a fairly liberal quantity can now be obtained on a basis that allows a yield of roughly 4¼ per cent. on the debentures, and 4¼ per cent. on the preferences. Metropolitan Consolidated 3½ per cent. preference at 73½, two points down on the week, returns 4¾ per cent. on the money.

Electricity Supply shares are slightly irregular. Falls have occurred in Charing Cross ordinary, Westminsters, and City of London ordinary, but Bromptons moved up to 38s. 9d., Metropolitans were 30s., and Edmundsons are a strong market at £3, with a rise of 5s. to their credit. This last-named is due, of course, to the excellent results shown in the last report, mention of which was made here a week ago. The preference remain unchanged at 4¼. Urban ordinary and preference are now quoted in their new £1 denominations, the prices being 15s. and 18s. 9d. respectively.

The decline in City of London ordinary may be partially due to the questions that have been raised lately in regard to the charges made in respect of lighting the City. The Charing Cross and City undertaking is understood to have replied to the Common Council by the very effective means of pointing out that charges have come down substantially since March, 1922, and also mentioning that the City part of the Charing Cross undertaking has paid no dividend on its ordinary shares for the past 22 years. The supply of electricity for City of London lighting has to be considered in a manner different from that which obtains in other cases, because the City is little better than a five days' customer, and there is, in the ordinary way, an insistent pressure for current during a comparatively few hours.

In which connection, it may be parenthetically remarked that the Stock Exchange has recently given up making its own electricity, and is taking current now from the Charing Cross and the City of London Electric Lighting Companies. The installation, which occupies a room below the floor of the Stock Exchange, is exceedingly interesting, and in addition to lighting the lamps for the underground offices, the machinery provides for the purifying of the air which is used to ventilate the House. The services of the two companies stand side by side, so that, if there should be a fault on one, the load can be transferred to the other. Normally, the two systems take an equal and a simultaneous share of the work.

Of the new issues, Lima Electric Lighting and Power 6 per cent. debentures, which came out at 90, fell to 2 discount and recovered to 10s. discount, while the 6 per cent. Tokio Electric Bonds, offered at 94, rallied to 5s. premium after being down to 35s. discount. English Electric 6 per cent. debentures, with £37 paid, are 2½ premium; North Metropolitan Electric debentures, £15 paid, 4½ premium; South Wales Power 6 per cent. debentures, also £15 paid, stand at 1 discount. The new Yorkshire Electric ordinary shares are 2s. 6d. premium, and Enfield Ediswan 7½ per cent. preference continue a heavy market at 1s. 6d. discount for the shares 5s. paid.

Mexican utility descriptions are heavy, and there has been no recovery from the weakness that developed at the beginning of the month. Mexican Light and Power 5 per cent. first mortgage bonds are 4 points lower at 66½; both classes of shares have shed 3. British Columbia Electric preferred moved up 2 to 81½. Brazilian Tractions, after dropping to 49, rallied a trifle, and are 1½ lower on the week. Anglo-Argentine Tramway 5 per cent. debenture gave way to 77½. British Electric Traction preference at 99 shows a point to the good, though the ordinary at 73½ is similarly lower.

India Rubber and Crompton's shares are weak at 11s. 3d., and small falls occurred in other parts of the market for shares in manufacturing companies. Whitehall Electric preference at 19s. 6d. are 6d. lower. The rubber market remains uninteresting and inanimate. Iron, coal and steel shares have been disposed to dulness on account of the fear lest the dockers' strike might extend into other branches of industry. The City waits with keen interest upon the result of the Bank of England Court's meeting on Thursday, though it is already declared that, if the rate should rise to 5 per cent., this is likely to prove but a temporary measure, and to be superseded by a lower minimum as soon as American financial problems become more normal.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price July 10. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	1½	+ ⅛	£6 2 6
Charing Cross Ordinary ...	5	9	14	11½	— ⅛	6 4 5
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 2 10
Chelsea	1	6	10	1⅞	—	5 14 3
City of London	1	14	15	2⅜	— 1/16	6 6 4
do. do. 6 % Pref. ...	1	6	6	24/-	—	5 4 4
County of London	1	8	10	38/9	—	5 3 3
do. do. 6 % Pref. ...	1	6	6	23/9	—	5 1 1
Edmundson's Ordinary	5	Nil	—	3	+ ¼	7 0 0
do. 6 % Pref. ...	5	12/-	—	4⅝	—	6 8 0
Kensington Ordinary	5	10	12	9½	—	6 6 4
London Electric	3	4	10	4 7/16	—	6 16 0
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11 7
Metropolitan	1	7	8½	30/-	+1/-	5 13 4
do. 4½ % Pref.	1	4½	4½	17/6xd	—	5 1 5
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	1	5	5	16/3	—	6 3 1
do. 7 % Pref. ...	1	7	7	24/-	—	5 16 8
Notting Hill, 6 per cent. Pref....	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	15/-	—	Nil
do. 5 % Pref. ...	1	2½	5	18/9	—	6 8 0
St. James' and Pall Mall ...	5	12	14½	11⅞	—	6 2 1
South London	1	7	10	1 13/16	—	5 10 4
South Metropolitan Pref. ...	1	7	7	1½	—	5 12 0
Westminster Ordinary	5	10	12	9⅞	— ⅛	6 3 1
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/6	—6d.	7 13 10

HOME RAILS.

Central London Ord. Assented	Stock	4	4	7¼	—	5 8 1
Metropolitan	,,	2½	3½	6	—2½	5 5 8
do. District	,,	1	3	49	—3	6 2 5
Underground Electric Ordinary	10	Nil	Nil		— ⅝	Nil
do. do. "A" ...	1	Nil	Nil	8/6	—	Nil
do. do. Income	Stock	4	5	95	—1	*5 5 3

TELEGRAPHS AND TELEPHONE

Anglo-Am. Tel. Pref.	Stock	6	6	104½	—1½	5 14 10
do. Def.	,,	1½	34/6	23½	+ ⅛	6 7 8
Chile Telephone	5	6	6	6¾	—	4 18 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	1	—	5 12 8
Eastern Tel. Ord....	Stock	10	10	180	—	5 11 1
Globe Tel. and T. Ord.	10	10	10	17½xd	—	5 12 8
do. do. Pref.... ...	10	6	6	11⅜	— ⅛	5 5 6
Great Northern Tel.	10	24	22	27½	— ½	8 0 0
Indo-European	25	10	7	30½	—	5 14 9
Marconi	1	25	15	2 7/16	— ⅛	6 17 0
Oriental Telephone Ord. ...	1	12	12	2 13/16	— ⅛	*4 5 1
United R. Plate Tel.	5	8	8	6¾	—	*5 16 4
West India and Panama ...	10	Nil	Nil	1/6	—	Nil
Western Telegraph	10	10	10	17⅞	—	*5 12 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8⅛	—	8 9 0
do. do. 2nd Pref.	5	Nil	5½	2 13/16	—	9 15 6
do. do. 5 % Deb.	Stock	5	5	77½	—2	6 9 0
British Electric Traction Ord.	,,	4½	5	73½xd	—1	6 16 1
do. do. 6 % Pref.	,,	6	6	99xd	+1	6 1 3
Brazil Tractions...	100	Nil	4	49½	—1½	8 2 4
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	88½	—1	5 13 0
do. do. Preferred	,,	5	90/-	81½xd	+ 2	*5 18 9
do. do. Deferred	,,	3	127/-	98	—	*7 2 6
do. do. Deb. ...	,,	4½	4½	79	—	5 7 7
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	9/6	—6d.	10 0 0
London United Tram. Deb. ...	Stock	4	4	69½	— 2	6 8 0
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	81½	—	6 2 8
do. 6 % Bonds ...	—	Nil	Nil	60½	—	Nil
Mexican Light Common ...	100	Nil	Nil	30½	—3	Nil
do. Pref.	100	Nil	Nil	57½	—3	Nil
do. 1st Bonds ...	—	Nil	5	66¼xd	—4	7 10 5

MANUFACTURING COMPANIES

Babcock & Wilcox	1	15	20	2 7/16	—	4 11 4
British Aluminium Ord. ...	1	10	5	18/9	—2	5 6 8
British Insulated Ord.	1	15	15	9 7/16	—	6 3 0
Callenders...	1	15	15	2½	—	6 0 0
do. 6% Pref.	1	6½	6½	23/9xd	—	5 9 5
Crompton Ord.	1	10	5	7/16	— 1/16	8 17 6
Edison-Swan	1	10	Nil	4/3	—3d.	Nil
do. do. 5 % Deb.	Stock	5	5	65xd	—	7 13 10
Electric Construction	1	10	10	1 13/16	—	6 16 1
English Electric	1	8	5	17/9	—9d.	5 12 8
do. do. Pref.	1	6	6	19/6	—6d.	6 3 1
Gen. Elec. Pref.	1	6½	6½	23/3	—6d.	5 11 10
do. Ord.	1	10	5	20/3	—6d.	4 18 9
Henley	1	15	15	2 7/16	—	6 8 0
do. 4½ Pref.	5	4½	4½	4½	—	5 0 0
India-Rubber	1	10	—	7/16	— ⅛	—
Mat.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	16.3	— 1/16	Nil
Telegraph Con.	19	20	20	20½	—	*4 16 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price July 11th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6½d.	½d. dec.
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£27	20/- dec.
a Copper Sulphate ... ... ,,	£26 10s. *	5/- dec.
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	5d.	...
a Shellac ... ... per cwt.	£13 15s.	15/- dec.
a Sulphur, Sublimed Flowers ... ,,	£8 10s.	10/- dec.
a ,, Roll ... ... ,,	£8	10/- dec.
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 10s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£115 to £120	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£169	£5 dec.
Grade II ... ... ,, ,,	£122	£4 dec.
Grade III... ... ... ,, ,,	£70	£2 dec.
c Brass (rolled metal 2" by 12" basis) per lb.	10d.	½d. dec.
c ,, Tubes (solid drawn) ... ,,	1/0 to 1/0½	½d. dec.
c ,, Wire, basis ... ... ,,	10½d.	½d. dec.
c Copper Tubes (solid drawn) ... ,,	1/1½d.	½d. dec.
c ,, Bars (best selected) ... per ton	£98	£2 dec.
c ,, Sheet ... ... ,,	£98	£2 dec.
c ,, Rod ... ... ,,	£98	£2 dec.
d ,, (Electrolytic) Bars ... ,,	£72 15s.	35/- dec.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£82 15s.	35/- dec.
d ,, ,, H.C. Wire per lb.	10½d.	...
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	6/6	...
h India-rubber, Para fine ... ... ,,	1/2½	½d. dec.
l Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ... ... ,,	£25 15s.	5/- dec.
g Mercury ... ... per bot.	£10 5s. to £10 10s.	5/- inc.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/2	...
p ,, drawn bars and rods ,,	1/3⅜	½d. dec.
p ,, rolled strip & sheet ,,	1/3½	...
p ,, wire ... ... ,,	1/4	...
o Platinum ... ... per oz.	£23	...
d Silicium Bronze Wire ... ... per lb.	1/1½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£182 to £182 13s.	20/- dec.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/-	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Technical Education.—The Cleveland Scientific and Technical Institution was registered on July 2nd as a company limited by guarantee, with the following objects:—To encourage and facilitate the continued technical education of the staffs and employés of the various industrial works in the Cleveland and Tees-side districts of England, to encourage the advancement of metallurgical, mining, engineering, and shipbuilding sciences generally, to provide lecture rooms, a technical library, a reading room, committee, recreation and other common rooms for the use of the Cleveland Institution of Engineers, the North-East Coast Institution of Engineers and Shipbuilders (Incorporated), and other *bona-fide* technical societies, &c. The management is vested in a council of not less than 12 or more than 24 members. The first Council is to consist of five members, representing the Cleveland Institution of Engineers, five representing the North-East Coast Institution of Engineers and Shipbuilders (Incorporated), one representing the Foremen Engineers' Association, one representing the Chartered Institution of Electrical Engineers, and six representing the donors to the funds of the Institution. In no case will the representatives of the Cleveland Institution of Engineers and the North-East Coast Institution of Engineers and Shipbuilders (Incorporated) number less than five respectively.

B.S. Specification No. 72/1917.—The British Engineering Standards Association announces the withdrawal of B.S. Specification 72/1917 from circulation. This document is now under revision, and will be divided into the following sections, each of which will be issued as a separate publication as and when ready:—(*a*) Industrial machines (B.S.S. 168/1923, already published); (*b*) large machines; (*c*) transformers; (*d*) rotary converters; (*e*) traction motors.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

ANNUAL CONVENTION.

(*Continued from p. 8.*)

Transmission and Distribution of Electricity by Overhead Lines.

By J. EDWIN STORR, A.M.I.E.E., A.M.I.Mech.E.

(*Abstract.*)

(*Concluded from page 7.*)

Perhaps the most satisfactory alternative to a separate line of light poles carrying the telephone circuits by another route is to contract with the Postmaster-General for an "A" to "A" circuit on the nearest G.P.O. pole line, by means of which a pair of wires are provided and maintained for the sole use of the subscriber.

No means of effectively avoiding excess potentials on overhead lines exists in practice. Horn gap arresters for pressures up to about 15 kV are frequently used, but require a series resistance to prevent the line current flowing through the arc. It is doubtful whether electrolytic arresters are really satisfactory because their start depends upon the puncturing of a solid dielectric. It is best to rely upon a substantial reinforcement of the insulation on the end coils of transformers connected to the lines. As much as 400 per cent. of the normal insulation is used, and disturbances on the line are reflected from the end coils and levelled out by line resistance. This method of protection is applicable to all lines connected on a network between step-up and step-down transformers. It is reasonably cheap protection, and neither requires attendance nor involves maintenance charges. It will be greatly enhanced by the use of cable terminations between line and sub-station. Such cables are made to a specification calling for low capacity (which provides a means for dissipating high-frequency surges in the line) and higher resistance to breakdown.

For low-pressure circuits, where the spans are shorter and consequently the sags much less, aluminium conductors will meet the requirements, and the advantages of reduced weight become marked in the construction of the supports; moreover, considerable economy in transport charges and cost of erection results from its use. It is, however, necessary to use much greater care in handling owing to its softness.

For certain classes of work copper-clad steel has enormous advantages, combining high conductivity with great tensile strength. Much more extensive use has been made of aluminium-clad steel. The compound conductors are made up of aluminium wires disposed around a central steel core, the wires of the latter being double galvanised. No galvanic action takes place between the aluminium and the zinc coating of the steel core. Stranded conductors are stronger than solid wires and less liable to kinking and over-stress during erection.

When stringing wires where different sizes of conductor (but of the same material) occur on the same pole, it should be remembered that all the wires will have the same sag if tightened up to the same stress (lb. per square inch).

Wires arranged in true triangular formation will result in equal voltage drop in all phases. If unbalanced (say all wires in one plane), the inductive drop in the outer wires is greater than in the middle wire. Transposition of the wires will avoid unequal phase voltages at the receiving end of the line and also remove any disturbance of telephonic or telegraphic circuits which are run on the same poles. When transposing power wires, special attention must be given to clearances between wires in intermediate spans.

Frequent transposition, say, every ¼-mile, of the communication circuit, close spacing of the telephone wires, and a maximum distance between the power and communication conductors, will reduce almost entirely any interference with the transmission of messages.

It is the best practice to make all joints in heavy conductors at poles, by mechanical means, to avoid any sweating, particularly where tension exists in the wire. Joints should be placed in loops without tension on the joint.

Joints in small wires can be made by twisted metal sleeves, as used by the Post Office Engineering Department.

When jointing aluminium, mechanical means are absolutely necessary. Aluminium clamps must be used, or aluminium-coated fittings.

The results obtained by substituting cable terminations for overhead lines where the latter are to enter buildings, fully commend the practice. A minimum length of 50 yards should be put down.

The erection of overhead lines raises the question of wayleaves. The Act of 1919 has materially altered the position. The consent of a local authority is no longer necessary. Unreasonable objections and excessive wayleave rents will be checked. There is little doubt that wayleave rents will gradually become standardised.

For high-voltage lines the Electricity Commissioners have announced the agreement with new factors of safety as follows:—Conductors 2.0; wood poles 3.0; steel masts 2.5, based upon a wind loading of 13½-lb. per square foot with an ice loading on the conductors of half an inch at a minimum temperature of 22 deg. F., the loading being taken on 0.6 of the diameter of the ice-coated wire. An allowance may be made for the elasticity of the conductor.

Each pole must have a number plate attached and a danger notice at road crossings and every fifth pole. Both plates should be fixed with a boss behind the plates to keep them away from the pole. Cast plates with raised letters and figures are much better than the cheap enamelled forms.

Lock nuts or other approved means of fastening nuts should be definitely specified. The vibration of alternating-current work in general is amplified in overhead construction and must be dealt with to gain security of operation.

The principal disadvantage of overhead line work is the greater cost of maintenance. Regular patrol work is of primary importance, especially after a storm of wind or sleet. Inspection of pole top work can be greatly aided by the use of moderately powerful field glasses. Any defects reported should have the earliest possible attention, and to ensure a line with minimum leakage losses the insulators should be thoroughly cleaned on the underside when painting is done, or more frequently in areas where a dirty atmosphere exists.

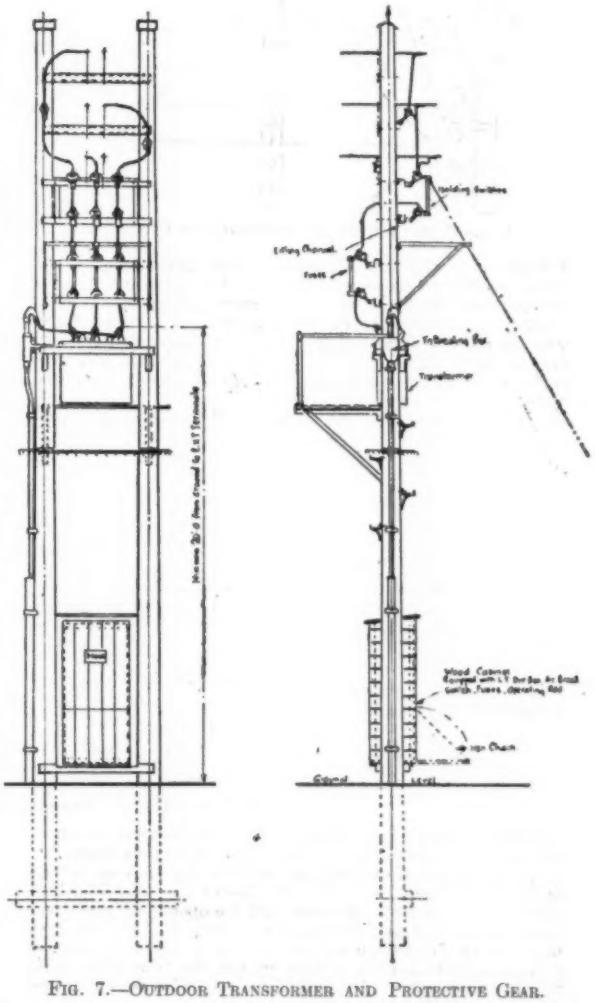


FIG. 7.—OUTDOOR TRANSFORMER AND PROTECTIVE GEAR.

Small demands arise for a supply from passing high-pressure lines, and will continue to increase in volume. These cannot be economically met by the brickwork sub-station and indoor equipment; consequently outdoor equipments have received considerable attention.

An economical arrangement of transformer and protective gear designed by the author is shown in fig. 7. The equipment can be mounted on an existing "H" pole, or by erecting an additional single pole alongside an existing one.

Isolating switches are mounted as near as possible to the tappings on the line conductors. These switches can be operated from the ground by means of a sectional rod (rod

in 6-ft. lengths, normally kept in the cupboard) and after all are withdrawn can be closed on to the earthing contacts below to ensure safety of working.

A little lower and behind the isolating switches tetrachloride-filled glass tube fuses are mounted. They are removed or inserted by hand from the platform, ensuring greater care than would be possible by pole operation. Short leads connect the fuses to the transformer terminals.

The transformer is specially built for weatherproof operation

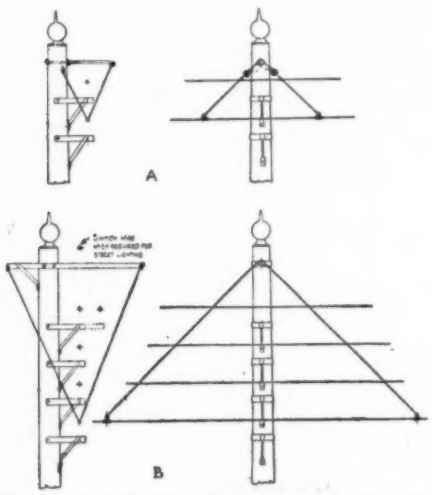


FIG. 8.—ARRANGEMENT OF DISTRIBUTION CIRCUITS.

and is provided with top insulators. It is supported from the cover to permit the removal of the tank for inspection without disturbing any electrical or weatherproof connections.

A low-pressure connection is made down the pole by approved means, and the consumers' or branch line control gear connected in the cubicle below. A special anti-climbing device is provided to prevent access to the platform except by authorised persons.

An equipment of this description for 25 kVA, 6.6 kV or 11 kV, 3-phase, would cost about £160. Single-phase arrangements can be similarly arranged at a corresponding cost.

A special switch fuse combined with a transformer in one tank has been designed by Messrs. Reyrolle & Co., in which the fuse is used as a switch blade and the opening of the cover operates the switch and isolates the equipment from the line. Severe tests on this switch unit made with a very large generating plant capacity behind it have proved the fuse to be quite satisfactory in blowing cleanly and without disturbance to the system to which it is connected.

The following notes refer to low- and medium-pressure work, and are intended to make a distinction between the work usually done for cross-country circuits and that for erection along the highways. Street work will have to conform to local needs and not unduly interfere with the amenities of the locality. The matter of appearance cannot, however, be given too much consideration; thousands of consumers of electricity to-day would still be without a supply if overhead work had been ruled out of court

Only by the use of overhead construction will it be possible to meet the demands arising in urban and rural district areas. The distributing system is the place where maximum operating economies can be obtained to-day by the application of good engineering, but care must be exercised to avoid a "penny-wise pound-foolish" policy.

Street work should be restricted to single poles, with steel units to take any unusual angle, so as to avoid stays and minimise the ground space required.

Junction places in low-pressure networks are best made with cables. Feeder pillars will probably be required, and the cable work will simplify the construction and keep the whole arrangement of simple appearance. All poles fixed at kerb lines should be protected by concrete fenders or bollards to prevent damage by wheel hubs of passing carts.

Road crossings for branch line or service work should be run as nearly as possible at right angles to the roadway and preferably horizontally. One road crossing, with cable branches along the face of buildings between consumers, is a much better arrangement than individual crossings. All service work must be taken off the distributor at pole positions, as mid-span connections are contrary to regulations.

A frequently adopted arrangement of distribution circuits is shown in fig. 8. The arrangement can be extended from a two-wire (A) to a five-wire circuit (B). The "Vee" guarding for earthing a broken conductor can be arranged for connection to a neutral wire or an aerial earth wire as the case may require, and top guarding can be provided by wires between poles on cross arms. Branch circuits can be taken off either side without diminution of clearance.

Another arrangement of distribution circuits is shown in fig. 9 (A), (B) and (C). In these designs, by Mr. George Dixon, A.M.I.E.E., of Brotton, adopted for probably the most extensive l.p. street distribution system in Britain by the Eston Urban District Council, tubular poles are used throughout; the balanced arrangement of wires shown in (B) and for crossings (C) results in a much shorter pole than would be needed if branch lines were strained off the arrangement of (A), and more satisfactory clearances are obtained.

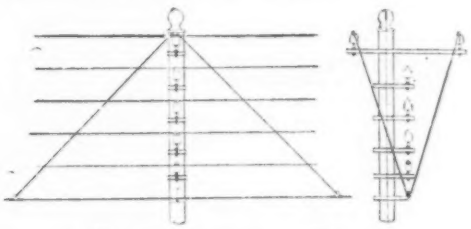


FIG. 9A.—DISTRIBUTION CIRCUITS.

The guardings shown are simple, easy to erect and maintain, and can be applied to split neutral wires as well as to a single wire. An excellent paper was read before the Institution of Post Office Electrical Engineers a few years ago by Mr. A. P. Trotter, in which the subject of guarding power circuits to prevent contact with other circuits was very effectively dealt with. Circular E 17, issued by the Post Office Engineering Department, is a useful guide in designing the guarding arrangements for street circuits.

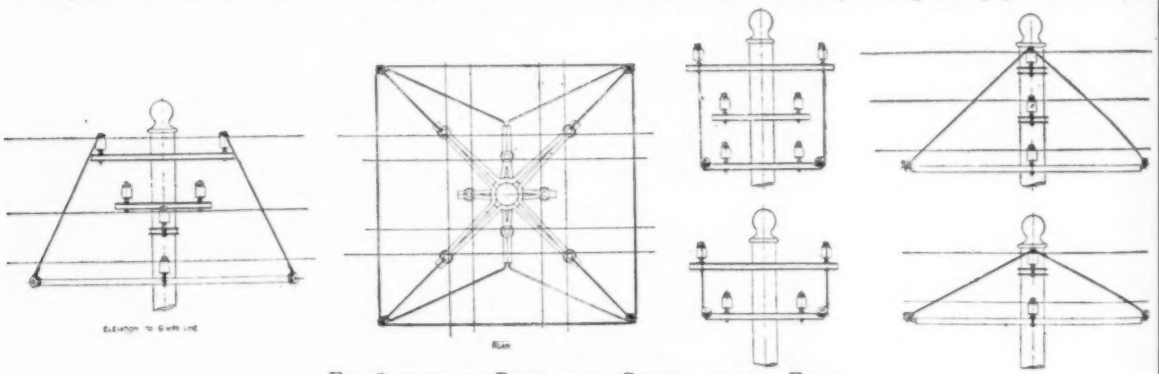


FIG. 9, B AND C.—DISTRIBUTION CIRCUITS USED AT ESTON.

The use of lattice steel poles is not advisable for street work unless special precautions are taken to prevent climbing. Suitable filling of the base for, say, 6 ft. up, with concrete or wood panels would act as an anti-climbing device.

Tubular steel poles make a more graceful job than wooden poles and have the advantage of additional strength within certain limits, if filled with concrete.

Roof and chimney-stack work is not good. Access for maintenance and repairs is difficult, and the sulphur content of the smoke has a rapid deteriorating influence on copper conductors, and combined with fine ash from the fires, makes maintenance an important item.

The average span length for distribution work is 50 yards. This may be reduced to 40 yards where frequent branch line or service work is wanted. Street lighting at 50-yard intervals is too often closely spaced, but lamps at alternate poles are too wide apart, and alternate poles on 40-yard spans are a good compromise.

The standard G.P.O. insulator is frequently used for 400-volt service with very satisfactory results. It is robust and cheap. Tension insulators should be used in all places other than a straight line. They made a much better construction than pin insulators for terminal and angle positions. Heavily galvanised bolts should be used for passing through shackle insulators to prevent bursting due to growth of bolt diameter by rusting.

Where it is desired to put in protection on a branch line and avoid the complication of bringing a connection down the pole to a fuse box, a fuse can be used. The whole unit is self-contained and at the same time functions as a terminal insulator. These special fittings give a flexibility to the network unknown where solidly jointed connections are in use, and branch disturbances are confined thereto by the fuses. The author is strongly in favour of mechanical attachments, if satisfactorily designed, for all connection work in preference to binding wires and solder.

A split phase wire can be run fairly close to the main phase wire, as shown in fig. 8 (B). This gives a line free for control of street lighting which can be made alive according to requirements by a time switch fixed at the nearest feeder or control point or mounted on the pole. Half and all-night lighting can, when required, be put on two different control lines or split phases, and be controlled by a two-pole time switch.

At Sheffield, Mr. Fedden has used span wires across the

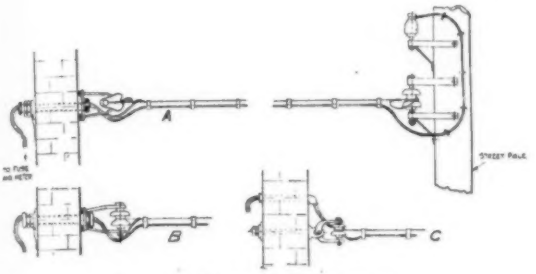


Fig. 10.—Service Connections.

street from wall fixings and suspended the conductor over the kerb line, making a very satisfactory job almost unseen in passing.

Alternative methods of making service connections are shown in figs. 10 and 11.

In fig. 10 the live conductor consists of a rubber-insulated sheathed cable suspended from a bare hard-drawn copper wire which forms the neutral. As an alternative, the messenger wire may be a branch of the aerial earth wire, in which case the neutral would be included as a core in the cable. The latter arrangement makes a good and effective earthing system for the meters, consumer's gear, and the wiring installation. For this lead-covered service cable a percentage of tin will be necessary in the lead sheath.

The bracket consists of a length of ¾-in. galvanised tube screwed at both ends. A 3-in. square plate washer is provided inside the consumer's wall to take the pull, and security is obtained by back lock nuts, a copper clip being also provided with connection to the earthing point. At the outer end of the leading-in tube a 2½-in. strain insulator is fixed, with external bushes to prevent abrasion. At the street pole end of the service a shackle insulator with its bracket and bolt is substituted for the pin type insulator supporting the line. The cable is suspended from the neutral or messenger wire by small moulded suspenders secured by a centre bolt.

The chief advantage of this service arrangement is its capability of taking either single-, two-, or three-phase services

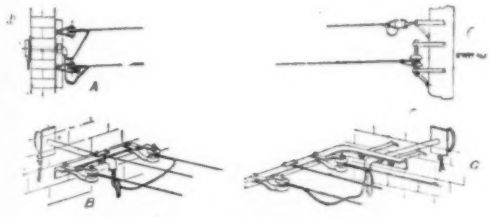


Fig. 11.—Service Connections.

without an increasing number of brackets and other fittings. Two-, three- or four-core cables would be used for such cases. The single hole through the wall is also an advantage, and the equipment is not so unsightly as a number of wires terminating on separate brackets. Alternative arrangements are shown as B and C of fig. 11.

In the arrangement of fig. 11 insulated wires are used, and both the neutral and phase wires are insulated. The protected wire shown as P.B.J. is suggested as an alternative to a rubber-covered wire. The arrangement of house service fittings has been designed by Mr. N. W. Prangnell, of Newcastle; alternative arrangements of the same gear are shown in fig. 11. An alternative insulator, fig. 12, embodying a shackle and fuse, is available should the branch line be of such proportions as to warrant fusing at the tee off.

While this is a fairly neat arrangement for a single-phase service, the additional brackets and wire required for multi-phase services would make the appearance rather unsightly.

The importance of earthing for street work and for lines attached to dwellings cannot be over-estimated, and in this respect it will probably prove the most satisfactory solution to carry an aerial earth wire throughout the system and use branches of this as messenger wires for service connections.

In the following table a brief comparison is made to show how much cheaper overhead construction is than underground

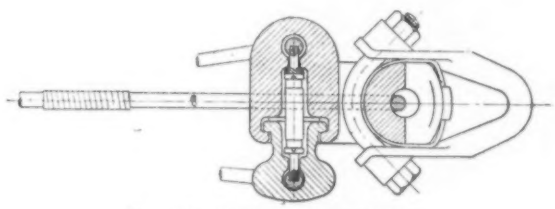


Fig. 12.—Insulator with Fuse.

work. This comparison is for equal route lengths, and does not show the very great saving due to overhead lines by the shortened route made possible by cross-country lines compared with underground work laid along the highways. The saving in capital cost much more than meets the charges due on wayleaves and increased maintenance.

TABLE III.

Voltage.	Underground Cables.	Overhead Lines.
33,000	£3,800	£1,080
11,000	£2,440	£950
6,600	£1,000	£450
Low Pressure	£846	£430

Electric Cooking Apparatus.

At the "informal meeting" held on June 20th, Mr. R. B. Mitchell (Glasgow), chairman of the Electrical Apparatus Committee, opened the discussion. He said that from replies to a questionnaire it appeared that to date there were approximately 5,000 electric cookers in service in this country, and probably 80 per cent. were installed under schemes of hire or hire-purchase. The number privately owned was negligible. In the year 1923, over 5,000 electric cookers would represent the output from manufacturers' works for immediate installation in the country. One manufacturer alone was turning out 50 cookers per week, so that the estimate of 5,000 for 1923 appeared to be modest. In Glasgow he had during the past 12 months installed over 500 cookers, but this was only a beginning. The cooker of to-day was reliable, and satisfactory in operation and running cost from the consumer's point of view. The oven and grill were superior to any competitive apparatus, whether oil, coal, or gas. At the moment this superiority could not be said to extend to the boiling plates, but progress had been made of late. The open type of plate with high loading appeared to be the nearest approach to the ideal. Used in alliance with a quick-boiling kettle, the cooker of to-day performed satisfactorily all ordinary domestic cooking requirements. When the business developed, and instead of 5,000 the requirements of the industry called for 50,000 cookers per annum, lower prices would undoubtedly be obtained. At this stage, whether individual buying or co-operative purchase was adopted, the orders must be shared among the several firms who had spent much money in profitless pioneer development. The rate of development would depend, as heretofore, on the research work of individual firms, aided to some extent by helpful criticism from supply engineers. Most of them were agreed that the time had not yet arrived for standardisation of design. Another questionnaire was to be sent round asking for information as to faults in design and their elimination, and it would probably be found wise to await the views of those numerous supply authorities who were now, for the first time, in a position to obtain first-hand experience of cookers in service. There was now almost complete agreement in the industry that the electric cooking load was a desirable one, and it was gratifying to note that the majority of engineers were in a position to offer a cooking rate low enough to attract the business. Agreed on these two essentials, he could foresee no limit to the expansion of this side of the business. A pleasant feature of the investigations which had been carried out was the cordial co-operation of the company undertakings.

Mr. S. T. Allen (Wolverhampton) said the I.M.E.A. had been directly interested in the question of standardisation of cooking apparatus for many years. In 1914 the sub-committee on electrical plant of the B.E.S.A. appointed a special panel to consider the question, and the I.M.E.A. was represented all through the inquiry. Opinions were generally expressed then that although no effort should be made to tie the hands of the designers and manufacturers of electric cookers in improving design, there were many essential features which could with advantage be made common to all cookers and incorporated in a preliminary specification. Mr. Allen then detailed some of the steps taken leading up to the final publica-

tion of Specification No. 106 by the B.E.S.A. in August, 1920, and added that, as chairman of the sub-committee of the B.E.S.A. now dealing with the matter, he had been asked to convene a meeting with a view to the revision of this specification. He had preferred, however, not to do that until he had brought the matter before the I.M.E.A.

Mr. J. CHRISTIE (Brighton) said that his committee in the past had spent a considerable sum of money on electrical apparatus, and a great deal of experience had been gained by hiring out apparatus. As a result, he had come to the conclusion that people who hired out apparatus did not take care of it as those did who obtained the apparatus on hire-purchase or by direct purchase, and now he was not hiring out any apparatus at all. His experience was that where electric cooking apparatus was carefully looked after there were practically no maintenance charges at all, and that was also the experience of many of his friends who had installed similar apparatus on his advice. An important point in connection with the collection of these hire-purchase accounts was that the electricity department should collect the money, because in that way they got more into touch with the consumers than if the accountant's department did it. The accounts were paid at the showroom, and it was possible to demonstrate new apparatus and give advice to the customers when they came to pay their accounts.

Alderman ROBINSON (Aylesbury) spoke of his own personal satisfactory experience of electric cooking in his house, where he had no gas supply at all.

Mrs. HOWIE (Walsall) said she had an up-to-date cooker which gave no trouble at all. The importance of periodical inspection could not be over-emphasised as a factor in adding to the popularity of electric cooking.

Mr. F. S. GROGAN agreed that at the present time standardisation of details might be dealt with, but he would vote against any proposition to standardise cooker designs as a whole in the present stage of development. The hire-purchase suggestion of Mr. Christie was a most excellent one, and steps should be taken to secure its universal adoption. The apparatus which he had been developing during the past five years was intended to meet the condition which had to be met to-day, which was to sell the apparatus in towns where it was necessary to hire the apparatus, and not send it out on hire-purchase. To do that it was necessary to bring the cost down to £10 or £15, and that was being done to-day. Further, to meet the cook's trouble he had arranged to secure a temperature in the oven of 260 deg. in ten minutes, with a further rise of 100 deg. in a further five minutes, and the temperature did not fall below 300 deg. for about 45 minutes. A complete cooking outfit could be operated at a consumption for four or five people, of far less than one unit per hour on average running. The quality of nickel-chrome varied so much that it was necessary to watch very carefully the material that came into the works. He hoped the I.M.E.A. would back him up in urging upon the Electrical Research Association that research in this direction should be carried out.

Mrs. Alderman HAMMER (Hackney) spoke in general terms of the advantages of electricity for cooking, and said that she had found much less shrinkage in meat than with other forms of cooking.

Mr. A. F. BERRY said there seemed to be much greater activity with regard to electric cooking everywhere in the world than in this country. He received inquiries from the Gold Coast, Santiago, Nairobi, and many other parts, and there were more cookers in use in the Empire overseas than there were in this country. Long before the war he had worked out that if the supply authorities gave consumers all they required in the way of electric cooking, the country as a whole would save, in the lessened cost of cooking, the entire cost of the British Army each year. It was essential that they should give a service comparable to that given by their competitors, and hire-out apparatus at a cheap rate. It was on the saving in electric cooking that he had so many data available, and these data had a great bearing on the quality of the food cooked. There were some people who could eat gas-cooked food and some who could not. He had a lot of information on the subject of gas cooking. He felt that electric cooking was a most serious matter, to be taken up by the industry as soon as possible.

Mr. W. A. TURNBULL (Aylesbury) described a cheap home-made water heater which consumed 1.5 kWh a day and gave 5 gallons of water at 140 deg., which was hot enough for washing-up; water could also be drawn off in a kettle and heated to boiling point very quickly at a very low cost for energy. A really good apparatus of this sort, properly made, ought to be obtained for £2, and the total cost to the housewife ought not to be more than 2d. per day; this would repay the undertaking the cost of hiring and energy, and leave a profit.

Councillor H. G. ODELL (Ilford) thought the supply undertakings should push the domestic load for all it was worth. They had held an exhibition recently at Ilford, and the greatest interest was shown in the cooking and similar apparatus. Ilford was only a small place, and the undertaking had inquiries in hand which it would take a long time to tabulate and deal with. That showed the desire of the public to have electricity for all these purposes. Gas cookers were hired out for something less than electric cookers, and it was a point to be taken into consideration; it was for the industry to create a sufficient demand to warrant the manufacturers' reducing their prices considerably.

Mr. G. WILKINSON (Harrogate) said that it had been found out by one of the Gas Commissioners in America that to maintain water boiling in a state of violent agitation required nine times as much heat as to keep it boiling quietly. Many operations could be carried out with water at a temperature two or three degrees below the actual temperature of boiling, and that reduced the amount of energy consumed.

Mr. W. A. GILLOTT recommended to those who were investigating faults a plan which he adopted some years ago of having a card index and a card for each detail of the apparatus, so that the exact number of times that piece came in for repair could be checked. This provided information which greatly helped the manufacturers in overcoming the difficulties they met with. It was still a vexed question whether the boiling plate should be open or enclosed. An important question was the diversity factor of electric cooking. On the first housing scheme that he had to do with, he anticipated 2½ kW of maximum demand per house. Each house had a connected load of 12 kW, but he found the maximum demand was only 800 watts per house. That was based upon 70 houses in one block. The suggestion that only hire-purchase should be adopted would greatly reduce the number of cookers in use, and the result would be to retard progress all round. By hiring-out, with an additional charge of ¼d. per kWh, a large amount of revenue would be obtained which would otherwise be lost.

Mr. J. W. BEAUCHAMP (British Electrical Development Association) emphasised the need for the development of the domestic load not only in the interests of the particular locality from which the engineers and committee members came, but from the point of view of the whole country. He was very anxious to see the number of cookers installed increased. Mr. Berry had mentioned that ovens could be made which would outlast the life of human beings; the attention of the Commissioners should be brought to this, because they were still working on the seven years basis for loans for apparatus. With regard to the use of electric cooking by the staffs of electricity works, judging by the show of hands on the first day, a very large proportion of chief engineers used electric cooking, and the next step was to see that the assistant engineers and the staffs used it.

Mr. L. L. ROBINSON (Hackney), who wound up the discussion, said that central-station engineers were timid with regard to electric cooking, because they were afraid of what it would do to their networks. He had with him a large number of curves which showed that the cooking and domestic load did not touch the ordinary peak. After seeing those curves he did not think station engineers need have any fear of the domestic load.

Exhibition of Cooking Apparatus.

An interesting exhibition of electrical cooking and water-heating apparatus was open at the Constitutional Club during the Convention. The firms invited to show their products were Messrs. Bastian & Allen, the British Electric Transformer Co., Ltd. (Tricity), the Brompton & Kensington Accessories Co., Ltd., Carron Company, the General Electric Co., Ltd., Messrs. George Nobbs, Ltd., the Hotpoint Electric Appliance Co., Ltd. (Falkirk), and the Jackson Electric Stove Co., Ltd. The first-named company showed the use of "Bastalite," a coating of which applied to the bottom of a bright pan increased its capacity for absorbing radiant heat from an open-type boiling-plate to an extraordinary degree. Various improvements in detail were shown in the cookers, which were all of the latest type.

Another Story.—The following is a "third-hand" anecdote, having come from *Forbes Magazine via* the *Metropolitan-Vickers Club News*:—

An electric stove company had a most peculiar damage suit filed against it. The plaintiff's petition contains these words: "Plaintiff alleges that this defendant represented to her that this stove would not become heated on the upper surface of the oven. The plaintiff, relying wholly upon this defendant's representations, placed her bath tub in the kitchen near the stove. That, upon emerging from the tub plaintiff's foot accidentally came into contact with the soap upon the floor and she was thus compelled to sit upon the stove. That, although she arose therefrom with all diligence, she discovered she had been branded 'H———47.'"

Awards to Petters, Ltd.—MESSRS. PETTERS, LTD., have been awarded a silver medal (the highest award) for their 12-14-b.h.p. cold-starting engine for paraffin or crude oils, exhibited at the Royal Agricultural Society's Show at Newcastle. They have also been notified of the award of a "Diploma of Honour" in the prime-mover class at the Brazilian Centenary Exhibition.

THE NATIONAL PHYSICAL LABORATORY.

Report for the Year 1922.—*Abstract.*

(Concluded from page 37.)

DURING the year under review, in addition to other work, the Heat Division of the Physics Department has been engaged in the study of various problems connected with the production of metal radio transmitting valves capable of large outputs. The main difficulty of the problem is the maintenance of a good vacuum in a metal vessel. A further difficulty is to obtain an electrically insulating medium capable of being joined to metal by an airtight seal, both insulator and seal being able to withstand the temperature necessary for the heat treatment of the metal. The problem may be attacked in two distinct ways:—(*a*) The production of high-vacuum pumps, either physical or chemical in their action, and mechanically strong and reliable, that are sufficiently simple in design and use to permit of their being permanently attached to the valve. (*b*) The production of a metal vessel either sufficiently dense and homogeneous in itself to be gas tight, or covered internally or externally with a layer of impervious material. Research is proceeding simultaneously along both lines.

Tests have been made on a photo-electric cell to ascertain the relative sensitivity to various wave lengths. The active metal in the cell in question was rubidium, the gas argon. The cell proved to have a maximum sensitiveness for light of wave length 5,000 A.U. The variation of sensitivity with voltage was tested, and it was found that the maximum voltage that could safely be applied to the cell was about 120 volts. A rough test of the absolute sensitivity was made, and it was found that one candle at 1 metre produced a current of 7.7 $\times 10^{-10}$ amperes.

When making new end-measuring bars a difficulty was that hardening and heat treatment of the longer bars could not be carried out uniformly for all lengths of bars, which resulted in varying coefficients of thermal expansion for individual bars. Absence of uniformity in coefficient of thermal expansion makes it necessary to make and measure the bars at a uniform temperature of 62 deg. F. As a remedy a method was sought for hardening short portions at the ends only of all the bars above 3 in. in length; in ordinary practice, however, it is not easy to harden the ends only of bars shorter than 8 in., and a special electric furnace has therefore been designed and made upon lines suggested by joint experiments of the Metrology Workshop and the Electricity Department. This furnace is now ready for practical test; it is estimated that, with it, parts of the ends of the bars, say from ¼ to ½ in. long, can be hardened without interfering with the remainder of the middle portion of the bars, which can be previously uniformly heat treated. Thus any individual bars in a set made of the same quality of steel would have closely the same coefficients of thermal expansion. This method of hardening should also largely eliminate the tendency to secular change in the bars.

In the Engineering Department an examination was made of a large magnetic clutch to discover why it had failed to transmit its designed power of 600 h.p. at 600 r.p.m. Calculations from the drawings showed that the clutch should be fully equal to its work. The winding was correct to specification, but the actual magnetic flux on the pole faces showed great variation in different parts. It was found that the air gap was far greater upon one half of the circumference than upon the other, and also that one face had been recessed considerably below the working surface, and the reduction of the effective surface thus produced was sufficient to account for the failure of the clutch at high loads.

In the Metallurgy Department some further work has been done on electrical resistance alloys of the Ohmal type. A very decided departure from the composition of the well-known manganin alloy has been made, and the results have been eminently satisfactory. The alloy in question, known as Ohmal A, is now regarded as the best material for standard resistances, and is being extensively used in the laboratory for that purpose. A quantity of wire of various gauges of both Ohmal A and Ohmal B has been supplied by arrangement to the British Scientific Instrument Research Association, and it is understood that it is being used in the construction of trial instruments.

In the Electricity Department, in connection with the measurement of wireless signal strength, it had been noticed that with every amplifier arrangement that was tried the actual amplification of a small applied steady potential difference was very much less than that calculated from the known characteristics of the valves and the magnitudes of the resistances, &c., involved. The discrepancy was so striking that it was thought desirable to discover the reason. It was eventually traced to the partial diversion of emission current to the grids of the valves. It was shown theoretically and proved by experiment that the internal slope resistance (*i.e.*, dv_g/dv_g) between the filament and grid of any given valve in the set acted as a shunt to the resistance inserted in the anode circuit of the preceding valve. This fact becomes immediately obvious on drawing the equivalent circuits of any ordinary valve amplifying set. The experiments were actually carried out with amplification under steadily applied voltage, but obviously the same considerations, complicated by inter-electrode capacity, apply to high-frequency amplification. The net result of the investigation was to emphasise the desirability of eliminating grid current as far as possible in all amplifier arrangements required for measuring purposes.

In the Radio Division of the Electricity Department the following is a brief summary of the chief points elicited during the investigation on radio direction finding:—

(i) That the mean observed wireless bearing of a transmitting station over a prolonged period may be in error from its true great-circle bearing by amounts varying from 1 deg. to over 20 deg. This error may arise from distortion of the incoming waves due to obstacles upon the earth's surface, such as buildings, trees, overhead wires, &c., and exact quantitative data are now available showing the effect of these under various conditions. In other cases the error may be due to metal work, such as a water-pipe or streak of metal several feet below the earth's surface.

(ii) In addition to this "permanent" error in the observed bearings, the latter are subject to variations both by day and night. In the daytime, *i.e.*, between sunrise and sunset, the extent of the variations is comparatively small, amounting to not more than 2 deg. or 3 deg., but at night the variations occur much more frequently and range up to as much as 60 deg. These variations appear to be of the same order in different parts of the country, although there is in some cases a marked distinction between the effects observed on different transmitting stations. Similar observations carried out on a ship at sea also show the variations to be quite prominent at distances of about 40 miles from land.

A transmitting station is in course of erection at the laboratory for carrying out special experiments on direction-finding, and also on the measurment of radiation. An aerial 450 ft. long has been erected on masts 100 ft. high, and a counterpoise earth screen has been designed to give both high efficiency for transmission and constancy for measurement purposes.

In the Electrotechnics section a range of gauges for the measurement of hydrostatic pressure during the operation of high-power oil switches has been produced which record the maximum pressures reached at different points in the oil. They depend on the impression made by a sharp point of definite form at one end of a light steel piston on a piece of copper or lead when the piston is exposed to the pressure to be measured. With the shape of point adopted and over the range of pressures between point and copper made use of, the pressure is found to be proportional to the area of the impression made. Different diameters of piston are chosen to suit the range of hydrostatic pressure to be measured. Experiments show that a range of pressure of about 5 to 50 lb. between the steel point and the copper gives satisfactory indications. Pressures of several hundred pounds to the square inch have been recorded close to the arc. The instruments can be fixed to any convenient part of the mechanism or suspended in the oil. The external dimensions of each are 35 × 18 millimetres, which could be considerably reduced if required.

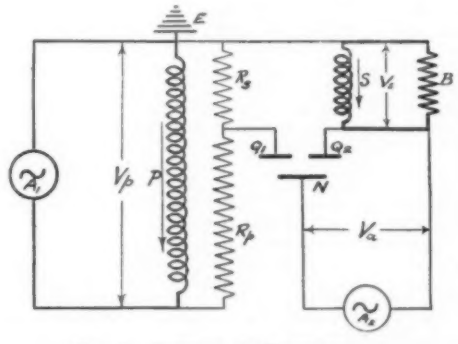


FIG. 1.—INSTRUMENT TRANSFORMER.

A sensitive and rapid method for determining the ratio and phase-angle errors of potential transformers has been developed. The circuit employed is shown in fig. 1. In this diagram P is the primary winding of the potential transformer under

test, supplied, through any necessary step-up transformers, by the alternator A_1, and S is the secondary winding across which any desired burden B is connected. $R_1 + R_2$ is a potential divider, the ratio of which is the same as the nominal ratio of the potential transformer. Q_1 and Q_2 are the quadrants of a sensitive reflecting electrostatic wattmeter. A_2 is an alternator, rigidly coupled to A_1, and maintains a constant voltage V_a, the phase of which can be varied by rotating the alternator stator, between Q_2 and the wattmeter needle N.

A reflecting electrostatic voltmeter (not shown) can be connected across R_1, S or A_2 by a selector switch. The test is conducted as follows:—

The electrostatic voltmeter is connected across R_2, and the primary voltage V_p is adjusted to the desired value. The wattmeter quadrants are then temporarily connected across a part of R_2, and the phase of the auxiliary voltage V_a is varied until the wattmeter reading is zero, when V_a is in quadrature with V_p. The wattmeter is then restored to its original connections, and its reading, say W_1, is taken. The phase of V_a is then altered by 90 degrees, than is, until it is the same as that of V_p, and the wattmeter reading, say W_2, observed. Since the ratio of the potential divider is the same as the nominal ratio of the transformer, the voltage across R_2 would be identical with V_s in magnitude and in phase if the transformer were perfect, and the voltage across Q_1 Q_2 would be zero.

Actually, however, these voltages differ in magnitude by an amount proportional to the ratio error of the transformer, and differ in phase by the phase angle. The voltage across Q_1 Q_2 therefore consists of a component in phase with V_p proportional to the ratio error, and a component in quadrature with V_p proportional to the tangent of the phase angle. Since the auxiliary voltage V_a is in quadrature with V_p when the reading W_1 is taken, this reading is a measure of the quadrature component, and the phase angle of the transformer may readily be calculated from it. Similarly the ratio error is obtained from the reading W_2. The sensitivity of the method is such that a deflection of 140 cm. is obtained for a ratio error of 1 per cent. for instrument transformers operating with a secondary voltage of 100. The same amount is obtained for a phase angle of 35 minutes. This sensitivity is much higher than is necessary, but is very convenient for rapid work. It has not yet been possible to compare this method with any other of like sensitivity for the determination of phase angle. Observations have, however, been made by this method on the ratio error of one 33,000-volt transformer, and also by measurement of the primary voltage by an electrostatic voltmeter with potential divider, and of the secondary voltage by an electrostatic voltmeter directly. These methods are independent except as regards the potential divider, the errors of which present a separate problem. Six comparisons were made at different secondary burdens, and the maximum discrepancy between two observations at a given burden was 1 part in 10,000.

TRAMWAYS, FROM A TRAFFIC POINT OF VIEW.*

By L. S. RAYNER (Manager, Hull Corporation Tramways).

THE difference between the average speed of the ordinary vehicular traffic to-day and 22 years ago is even greater than that between the horse car and the electric car of that day, and the public are inclined to expect that passenger transport on the roads shall still retain the same superiority of speed over the ordinary road traffic that obtained 20 years ago, but the advent of the commercial motor vehicle has made that impossible; it has, however, imposed the necessity of providing the fastest possible passenger transport compatible with safety, and it is the question of speed which I consider the greatest problem in tramway operation. Speed in itself is no problem, it is a simple matter to design and build a tramcar to travel at any speed, and if we could rebuild our cities with streets up to 120 ft. wide with tracks to accommodate different classes of traffic, tramways would fear no competitors or criticism on this score.

It is not possible to re-design and re-build our cities, and the only alternative is to make the best use of existing thoroughfares, to re-model entirely our ideas, to cease thinking of thoroughfares as having an unlimited capacity for traffic of varying capacities and speeds, and regard them as tracks with a limited capacity, and to regulate the vehicles upon them both as to type and speed—high as well as low—if the full capacity of our streets is to be developed. The time is coming, if it has not already arrived in some of our cities, when a definite speed will have to be maintained in certain streets and only vehicles capable of attaining that speed will be allowed to use them—at any rate at certain times of the day—and the overtaking and passing of vehicles prohibited. The alternative is the making of new streets at an enormous expense, which would fall not only on the user, but on the disinterested ratepayer as well.

I have taken some rather interesting tests of comparative speeds of omnibuses and tramcars under varying conditions and densities of traffic. The data was obtained by timing, with a stop-watch, cars at short intervals along the whole of the journey, and also taking the time of loading and unloading passengers and doing the same with omnibuses along the same routes under as nearly similar conditions as it was possible to obtain; it was found that up to 1¾-2¼ miles from the centre of the city through the denser traffic and narrow streets with a maximum number of stops there was no difference between the two, but after that, in the broader roads with diminished traffic, the advantage lay with the omnibus.

At each stop the tramcar made a temporary gain of 20 yards on the omnibus, due to better acceleration. It also had a distinct advantage in speed of loading. It was found that, in timing the speeds of each vehicle over every quarter mile throughout the run, the same results were obtained, and it is not until conditions permit the omnibus to use its superior speed that any real difference is shown. It is interesting to note that the average speed of the London County Council tramcars is 9.29 m.p.h. as compared to 8.5 m.p.h., being the last published figure for the omnibuses. This comparison does not take into account the relative seating capacity of the two vehicles. On this point the tramcar has the advantage.

Comparing the latest type of tramcar with the latest type of omnibus in use, the capacity of the tramcar for all weathers is approximately double that of the omnibus, and the bigger platforms and wider entrances give it a great advantage in the loading and unloading of passengers. In the second case the cost of the tramcar is always a decreasing figure as the numbers to be moved increase, whereas, with the omnibus the cost is practically constant. The last consideration is comparatively new but one of increasing importance.

The fact that tramcars are restricted to a fixed track, although it may at first sight appear a disadvantage, ensures that each tramcar shall take its proper station. If all other vehicles did the same and the overtaking and passing of vehicles were eliminated, the capacity of our streets and the average speed and safety of transport would be materially increased.

The value of a tramcar lies in its capacity and safety. Under the best climatic conditions one car is approximately equivalent to two omnibuses and, under bad conditions, three omnibuses would be required to do the same work. The question of capacity relatively to speed is receiving the closest attention of tramway managers; the size of the tramcar is rapidly approaching its economic limit, but there is a considerable margin left before the capacity of the track is exhausted. The capacity of the track is important, not only from a passenger-carrying point of view, for it has a great financial value. The track represents one of the chief items of capital expenditure and a heavy charge in the maintenance account and, consequently, has an important effect on the cost per car-mile; obviously, the greater the car mileage the lower the track charges per car-mile. The total maintenance and renewal charges do not vary in anything approaching direct ratio to the car-miles.

In comparing the figures of various lengths of track which have recently been relaid in Hull it was found that the total car mileage per mile of rail varied from just over 3,000,000 to just over 6,000,000, and yet there was comparatively little difference in the section of the worn rails; the joints are, of course, the weak spot, and the paving, which is not worn at all by tramcars, but is maintained at the tramway's expense, is not a weak spot—it is an imposition. To obtain the greatest value for money spent it is essential that the most efficient use be made of the track, and the factor governing this is headway. Headway is dependent upon speed of loading and unloading, and acceleration. The latter has been improved, and with the higher powered motors now in use is satisfactory, but the question of loading and unloading is a different story. It is of little use increasing the size of tramcars if the restricted exits of the smaller cars are retained. Larger cars demand better exits, or the necessary headway between cars is increased instead of decreased, thus discounting the advantages gained by the increase in the size of car.

It is interesting to trace the history of tramways from the financial standpoint, because it gives a key to the financial position of some of the less fortunate undertakings to-day. It is, of course, the heavy initial capital expenditure on the track and overhead electrical equipment which is the most

*Abstract of paper read at the Institute of Transport's Annual Congress, Sheffield.

serious item in the construction or extension of tramway systems and the very important bearing that the charges on this account have on the financial results of an undertaking. It is on this issue that the omnibus, as a single and complete unit, has the advantage, and it is only when the remunerative mileage reaches a figure at which the capital charges per car-mile are a reasonable figure that tramways enter the field. As the cost of construction has increased, so has the scope for tramways decreased and the field for omnibuses and railless omnibuses increased. In the case of the sleeper-ballasted track there is a remarkable difference in the cost, which works out at one-third of the price of the paved track, and the maintenance at 20 per cent. or even less than that of the paved track. It also follows that, in the majority of cases where sleeper track can be used it is possible materially to increase speed and, therefore, the earning capacity of rolling stock.

Dealing with the comparative capital charges of the two types of rolling stock, the very serious difference in the lives of the two must be taken into account. Assuming an approximate equality in the cost per seat, the omnibus must be depreciated at from 5/7 years as against the tramcar with a safe depreciation extending over 17 years, which gives an advantage in favour of the tramcar of 250 per cent.

Dealing briefly with running costs and taking the best figures in each case and where the ownership is the same, there appears to be very little difference in the cost per car-mile. The great difference is that, although the car and omnibus mile costs are approximately the same, the capacity of the tramcar is 100 per cent. larger than that of the omnibus and, therefore, the average load is better. It is important to remember that mileage has a greater effect on tramway costs than on omnibus costs. The tramways are handicapped in the matter of road maintenance charges and also rating, both of which it is hoped to see adjusted.

The great difference between London and the provinces is that the load curve for London has two peaks while the curve for the provinces has three, the reason being that a large number of the inhabitants of provincial towns are able to get home for their mid-day meal. The smaller the town, within certain limits, the more pronounced is the mid-day peak.

The characteristic daily load of the Hull tramways may be taken as typical of all the larger provincial systems. It is a distinctly better curve than the one for London. The peaks represent approximately 50 per cent. of the total passengers carried and the load factor, *i.e.*, the mean load referred to the maximum load, is 54 per cent. The number of journeys per head of population per annum equals 213. The ratio of the peak loads to the basic load and their diversity have a most important bearing on economic problems; in dealing with the whole load if the load factor is low, then the cost will be high and, if the diversity is bad, this also reflects on the cost.

The railways have realised where unnecessary competition was leading them and, with a view to self-preservation and the retention of an economic fare, have adopted the group system. The same conditions are appearing in the passenger road transport of towns, and it is imperative that something should be done to prevent chaos if cheap transport is to be retained. There must be co-ordination, it is impossible to have economical and cheap transport with an unlimited number of agencies dealing separately with the same traffic problem.

The outstanding feature is the low average number of passengers per car-mile, 14.34, in comparison with the average passengers per car-mile during peak load periods, but this is unavoidable. In short distance passenger transport a frequent service must be retained; there is a critical point at which the reduction of a service must stop if there is to be any service at all. It is on this point that the tramcar with its greater capacity has the advantage. In London the peak loads are largely dealt with by the tube railways and tramways. In the provinces the tramways have to deal with them.

It is interesting to compare the passengers per car-mile in 1912 and 1922—10.97 and 14.34. The average fare paid per passenger—0.87 pence and 1.39 pence, and the cost of running; also to note that, in spite of the cost per car-mile having increased 125 per cent., the passengers per car mile have only increased 34 per cent. and the fare paid 59 per cent. This is due to greater efficiency, the elimination of waste mileage; larger cars and higher speeds.

Tramways are, and will remain, a necessity in large towns and cities. There is no form of road transport that can deal with mass passenger transport as cheaply and effectively as tramways. The motor omnibus has a useful and increasing sphere of operation, but the tramcar has also increased its usefulness, and the effectiveness and capacity of tramways are by no means exhausted.

SWEDEN'S TRADE AND INDUSTRY.

STATISTICS of Sweden's electrical trade do not at first sight hold out much promise to British exporters of electrical goods. These imports fell in value from Kr. 10,655,000 in 1921 to Kr. 4,023,000 in 1922. Meanwhile, the value of exports dropped from Kr. 18,128,000 to Kr. 10,877,000. Sweden overbought excessively in 1920 and fairly considerably in 1921, but it is reasonable to expect that during the current year she will advance a long way towards the resumption of normal purchasing abroad. Her return to comparative prosperity would have been complete before now had it not been for labour troubles. The continued unsettlement in Central Europe and the failure of Russia have, of course, been delaying influences, but as far as Sweden's internal situation is concerned, the drastic liquidation of accumulated stocks has restored her import markets to virtual stability.

The British Commercial Secretary at Stockholm (Mr. H. Kershaw) says in his recent report* that there are welcome signs that the great body of British traders are commencing to grasp the factors which govern the economic life of Sweden, and to realise that the country consists of something more than great lakes, forest lands, fields of iron ore, Lapps and reindeer, &c. The present time, he says, could hardly be improved upon for commencing operations in Sweden, and the business done later will be in proportion to the preliminary investigations and activities carried out now. German competition subsided to a considerable extent in 1922 and, it may be added, has fallen off further since. The decline has been conspicuous in connection with many engineering and machinery products, belting and rubber manufactures. German prestige, says Mr. Kershaw, is undoubtedly suffering through the disposal of inferior goods in the Swedish market.

Attempts are still being made to develop trade between Russia and Sweden. Last December the first Soviet-owned steamer, the *Dekret*, 456 tons net, arrived in Stockholm. The nature of its cargo was not such as to inspire confidence in Russia's present resources of raw material. It consisted of 1,225 bales of linen rags. The commodities purchased from Sweden by the Soviet Government at the time when it had gold at its disposal were principally products of the metallurgical industries, electrical equipment, and agricultural implements.

Railway Electrification. Regarding the progress made in railway electrification, the Commercial Secretary reports that at the beginning of 1922 the Riksgransen-Nattavaara line (277 km.) of the Lapland ore railroad was electrified. At the end of March the electrification was extended 21 km. to Boden, and at the end of June the whole main line from Riksgränsen to Lulea (a total of 434 km.) was electrified. Further work is now being carried on at Gällivare, where the lines up to the ore mines are being electrified, and at Lulea where the switching and export yards at Svartön are being electrified. The Norwegian part of this railroad from Riksgränsen to Narvik is also under electrification. The total number of electric locomotives in use on the line at the end of the year was 41, together with two motor cars. Nine more locomotives of the strongest type are on order and will be delivered in 1923. As regards the electrification of the Stockholm-Göteborg line, two committees were sitting in 1922, one of which delivered its recommendations at the end of the year.

Radio-Telegraphy and Telephony. The report refers to the contract entered into last year by the Swedish Telegraph Administration with the Radio Corporation of America for the supply of radio apparatus at a cost of about £100,000. The entire cost of erecting the station is put at about £275,000. During 1922 the two small wireless stations belonging to the Swedish Waterfall Board, *viz.*, the half kilowatt stations at Porjus and Suorva, handled not less than 13,450 telegrams each, not including Press messages and the like received daily from Swedish and foreign wireless stations. In 1921 each station handled 12,008 telegrams.

During 1922 the Swedish public learning of the achievements accomplished in Great Britain and the United States, manifested great interest in the development of wireless broadcasting, and, as the manufacture and use of wireless apparatus is prohibited by law, many applications were submitted to the authorities for permission both to manufacture and to use apparatus. The Swedish Telegraph Administration (Radio Bureau), having devoted considerable attention to the question, with a view more particularly to avoiding the confusion which has occurred in the use of wireless telephony in the United States, has now proposed that a system should be adopted similar to that which obtains in Great Britain.

Water Power. The report refers to the steady progress which is being made in Sweden in harnessing waterfalls for the generation of electrical energy. The movement has received an additional impetus in recent years owing to dear coal, excessive manufacturing costs generally, and the consequent need to avoid the importation of fuel as far as possible. The developed capacity of waterfalls in 1921 was estimated at about 1,269,000 h.p., whilst a further 130,000 h.p. was under construction. Two new stations began work at the beginning

*H.M. Stationery Office or D.O.T. Price 2s.

of 1922, *viz.*, the Motala installation (12,000 h.p.) and the installation at Forshuvud in Dalälven, belonging to the Stora Kopparbergs Bergslags Company (about 15,000 h.p.). Among the more important work in hand at present may be cited the State power station at Lilla Edet in the Gota river, which it is intended to equip with three sets, each yielding about 10,000 h.p. Work on the State power station at Harsfranget, which will yield eventually about 150,000 h.p., has been suspended owing to the general economic depression and the consequent decline in the demand for electric energy. In central Sweden the State owns the hydro-electric stations at Trollhättan, Alkarleby and Motala, and a steam reserve plant at Västeras, in addition to important waterfalls in the north of Sweden. Expert investigations have revealed the fact that there are about 40,000 million kilowatt-hours of water power annually available in Sweden. The present consumption of electric power is estimated approximately in the following proportions:—Pulp and paper mills, 60 to 65 per cent.; sawmills, 7½ per cent.; iron and steel works, 20 per cent.; miscellaneous industries, 7½ per cent.; and textile mills, 2 per cent.

Mr. Kershaw makes some interesting observations concerning the so-called eight-hours' law, which Swedish industrialists condemn as a heavy drag on production and injurious to their export trade. It is in force provisionally until the end of this year, and there is a party in favour of its continuance for two or three years. Mr. Kershaw believes that in order to adjust working times to the peculiar Swedish climatic conditions (long winters and short summers), some modifications will be introduced to bring about more elasticity in the operation of the law, such as the limitation of the number of hours by the year, instead of by the day or week.

LEGAL.

Clonakilty Electric Light and Power Co.'s Appeal.

[VALUATION JUDGMENT.]

AT Clonakilty, Co. Cork, Quarter Sessions last week, Deputy Judge Meredith gave judgment in the case of the Clonakilty Electric Light and Power Co., Ltd's., appeal against the valuation of the Commissioner of Valuation. In delivering his decision, his Honour said: This is an appeal against a valuation of £185, made upon the rateable property of the appellant company. Under Section 7 of the Rateable Property (Ireland) Amendment Act of 1860, the subject matter of the valuation includes the motor power in the premises, but excludes the value of any machinery which is not erected or used for the production of motive power. The first question that arises is whether the dynamo, switchboard, motors, and accumulators are or are not machinery erected or used for the production of motive power. Now, the machinery in question is, of course, erected and used for the production of electricity, which, as the very name of the undertaking shows, may be regarded as motive power; but that electricity is the commodity produced and supplied by the company. The motive power evidently contemplated by the section is motive power employed on the premises for the purpose of the works of the undertaking itself. There are engines on the premises which produce such motive power, and they are properly machinery to be included in the valuation. But the dynamos and other machinery in question are only concerned with the application and use made of that motive power. This distinction was very clearly recognised in the case of the Commissioner of Valuation *versus* Clones Electric Lighting Co. Accordingly the machinery in question must be excluded from the valuation. The valuation of what is properly rated is to be based on an estimate of "rent for which, one year with another, the same might in its actual state be reasonably expected to let from year to year, the probable average annual cost of repairs, insurance, and other expenses (if any) necessary to maintain the hereditament in its actual state, and all rates, taxes, and public charges if any (except tithe rent charge) being paid by the tenant." For the purpose of the estimate, the hypothetical tenant may be supposed to be a prospective incoming company that contemplated taking over the undertaking as a going concern, as all rated property is supposed to be taken, at a rent on a letting from year to year, the company naturally reckoning on paying the rent out of the revenue. But capital has to be provided for the purchase of the non-rateable property. The value placed on this property is £2,188. If, then, a probable return of 10 per cent. is taken as about what would tempt capital into the concern, then 10 per cent. on that sum must be deducted from probable net receipts. A further 5 per cent. on the same sum should also be deducted to allow for renewals, and 2½ per cent. for contingencies; then a similar 10 per cent. should be allowed on the capital that would have to be raised to provide floating capital. On the evidence I estimate the requisite floating capital in the present case at £300. Hence 17½ per cent. on £2,188 and 10 per cent. on £300, making in all, say, £413, must, to begin with, be deducted from the probable net receipts. The receipts I estimate at £600, for it is not sufficient simply to strike an average for three years, and the Commissioner has, to my mind, not sufficiently taken into consideration the exceptional character of the revenue in the year 1920. The sum of £600, less £413, that is to say £187, is what the hypothetical tenant company could afford to pay for rent, so as to give an adequate return on invested capital, were it not that the amount of the rates payable on the valuation would have to be discharged; as the rates are 16s. in the £, the rent would be £104. Accordingly I find that the proper valuation is £104, and not £185. The Commissioner has adopted a method of computation which differs from the foregoing in that it allows a deduction from the revenue in respect of renewals of machinery used for the production of motive power, and admittedly rateable. That deduction is, in my judgment, contrary to the provisions of Section 2. The rateable property is assumed to be rented under a letting from year to year, and the tenant is expressly assumed to be liable for repairs, and an allowance in that respect has, in fact, been made in calculating the net annual revenue. No doubt an actual purchasing company would have to provide a sinking fund to meet renewals, but the rent which determines a valuation under the Act, is based on assumptions which, however fictitious, must be strictly observed. The deductions allowed by the Commissioner would, if permissible, considerably reduce the £104. The Commissioner, though his valuation is so much in excess of that which I have found, also makes a reduction of 25 per cent. on the valuation of £246, reached by the calculation which he has submitted, that is called a "reduction to make relative." The valuations generally in the locality are old, and are admitted to be on the average all too low. Hence if the strictly proper valuation is placed on the premises in this case an unfair burden is thrown on the appellants. A sort of local equation is admitted, and in accordance with that equation the figure arrived at in accordance with Section 2 is reduced by 25 per cent. In that way £246 is reduced to £185. However fair this reduction may be, it is not suggested that it has any legislative sanction, and I cannot hold that I am at liberty to follow the practice, and reduce the £104, which I have found, by any percentage whatever. Accordingly the appeal must be allowed, and the £185 valuation be reduced to £104.

Mr. J. A. McCarthy, B.L., was for the appellant. Mr. E. J. McElligot, K.C., was for the Commissioner of Valuation, respondent.

British Thomson-Houston Co., Ltd., v. Ridley.

MR. JUSTICE RUSSELL, in the Chancery Division on July 6th, had before him the motion, adjourned from the previous week, of the plaintiffs against C. Ridley, of Middlesbrough.

His LORDSHIP had granted an *ex parte* injunction to the plaintiffs, restraining the defendant from selling incandescent electric lamps that, it was alleged, infringed their letters patent, and also leave to serve notice of motion on the defendant.

Counsel for plaintiffs said the defendant had not appeared, and he asked for the injunction to be extended until the trial.

This was granted.

Beresford v. Grace.

SIR FRANCES NEWBOLD, one of the High Court Official Referees, on July 6th, heard an action in which Mr. W. Beresford, of 32, New Street, S.E., claimed from Mr. Alfred Grace and H. & E. Lea, Ltd., of Brewer Street, Regent Street, W., £282 16s. 7d., balance of commission at the rate of 40 per cent. connected with an electrical business in which plaintiff was engaged.

Mr. WORT, who appeared for the plaintiff, prefaced his opening statement of the case by announcing that any difference in regard to the figures would be settled on one simple principle which had been agreed between the parties; but there was a question as to liability—whether the liability was upon Mr. Grace or H. & E. Lea, Ltd. Counsel said that Mr. Beresford, the plaintiff, was for many years manager of the Hendon Electric Supply Co., Ltd., and in that capacity became acquainted generally with the electrical business, and came into contact with Mr. Alfred Grace, the first defendant, who in March, 1919, was carrying on the business of a builder. When H. & E. Lea, Ltd., was started, Mr. Grace suggested that they should together start the business of electrical engineers on arranged terms. Negotiations took place, and the correspondence that passed showed that the person who made the contract with plaintiff was Mr. Grace and not Lea, Ltd. The business was carried on in accordance with the terms arranged, but plaintiff had never been able to get an account. Defendants denied having made the contract, and said that there was a partnership and they were willing to have a partnership account taken.

Mr. FLETCHER (for the defendants) said that notwithstanding this the plaintiffs took out a specially endorsed writ upon which the Master sent the whole matter to the Official Referee.

Sir FRANCIS NEWBOLT, in giving judgment, said there was really very little in dispute between the parties, and he entertained little doubt as to the result. Originally a difficulty arose as to the liability of the two defendants, but it was clear that plaintiff must have judgment for a sum of money against both defendants, for they were indistinguishable commercially. He would give judgment against both defendants, treating the company as a defendant. The action was brought for a sum of profit due to plaintiff in the working of a joint adventure. It did not matter whether the parties were in such

informal partnership or whether it was a mere contract of employment. There was no doubt a community of interest between the parties, and it became necessary to calculate what was due to the plaintiff. It was clear that plaintiff was entitled to something, and that that something was 40 per cent. of the profits. There must be judgment for the plaintiff for the amount on the writ, £267 10s., with costs.

Gilson v. Brinsley's.

THIS case, which was reported in our last issue, proceeded a stage further on Monday last, in the Mayor's & City of London Court, when Mr. Robertson, appearing for Capt. McEachern, the original defendant, applied for an order for costs against a solicitor, Mr. F. O. Chinner, who, it was alleged, acted without Capt. McEachern's authority. The application was supported by the defendants.

Mr. A. O. Charles, K.C., for Mr. Chinner, said that his client had acted upon the specific orders of Mr. Garde and Miss Ainge. He stated that Capt. McEachern was fully cognisant of what Chinner was doing, and he had acted for Capt. McEachern in other matters. Counsel admitted, however, that his client had never actually seen Capt. McEachern, having always acted upon instructions by Miss Ainge.

Judge SHEWELL COOPER allowed the application, saying that Mr. Chinner must pay the costs thrown away by acting as he had done without being authorised by Capt. McEachern.

London's Electricity Supply.

THE case of the King *v.* the Electricity Commissioners—*ex parte* London Electricity Joint Committee and others—came before the Court of Appeal on July 9th, upon the appeal of the companies from the judgment of a Divisional Court discharging rules *nisi* for *certiorari* and prohibition which had been granted against the Electricity Commissioners by another Divisional Court. The previous proceedings were reported in the ELECTRICAL REVIEW of March 23rd, and April 6th, 1923. The case was opened on Monday and adjourned to Wednesday, July 11th.

Madras Electric Supply Co., Ltd., v. P. & O. Steam Navigation Co., Ltd.

In the King's Bench Division on July 6th, Mr. Justice BAILHACHE heard further evidence in this claim for damages, brought by plaintiffs in respect of the loss of a heavy electric stator over the side of the s.s. *Nagoya* in Madras harbour.

The parcel was recovered, but reconditioning was necessary, and in respect of the damage done the plaintiffs claimed £5,756 12s. 8d.

Defendants, in their defence, said that the damage was due to accident or defect in the ship's tackle or to erroneous judgment on the part of the officers, and that they relied upon the various exceptions and conditions.

Mr. WRIGHT, for the plaintiffs, argued that the defendants could not rely upon the exceptions with regard to unseaworthiness, because the exception was a qualified one and did not apply.

Mr. PHILIP FRANKLIN LLOYD, of the commercial and engineering export department of the British Thomson-Houston Co., said in evidence that he had charge of the contract for the stator. It was to form part of a turbo-generator set, and consisted of a cast-iron frame in which there were laminations with slots for copper rods or wires insulated by certain material. After its immersion in the salt water it would have to be rewound and dismantled. That required very special skilled labour, not available in Madras. Special apparatus would also be required to put the windings in the slots and make the proper connections. Mere drying would have been useless without rewinding. In those circumstances it was essential that the stator should be sent back to this country. They estimated that it would take six calendar months to recondition it. In the works they happened to have another stator belonging to another set and they decided to send that out to Madras to replace the damaged one.

WITNESS added that their cost of reconditioning the stator supplied to the Madras Electric Supply Co. was estimated at £3,850.

His LORDSHIP, giving judgment, said he was satisfied from the whole of the evidence that a preventer guy ought to have been rigged up when the stator was dealt with at Madras. There was a consensus of opinion among the witnesses about that, and he had come to the conclusion that the accident might have been prevented if that had been done. The vital question in the case was whether the absence of that emergency guy was an error of judgment on the part of the master, or whether it constituted unseaworthiness on the part of the ship. His view was that the failure to use the emergency guy was an error of judgment amounting to negligence on the part of the master. There was tackle on board which might have used if he had thought it was necessary, and in those circumstances the accident was not due to any unseaworthiness of the ship. The exceptions in the bill of lading prevented the plaintiffs from succeeding in the case. The defendants were not liable for the damage caused. If he should be wrong about that and the Court of Appeal should find that the vessel was unseaworthy, his Lordship assessed the damages at £4,242.

Judgment was entered for the defendants, with costs.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

16,233. "Telegraph and telephone apparatus." A. E. Christie (J. A. Sanhueza). June 22nd.
16,242. "Illuminated sign." F. W. Waggett. June 22nd.
16,258. "Electric relays." Western Electric Co., Ltd. (Schrieber). June 22nd.
16,265. "Gas electrode." A. Schmid. June 22nd. (Switzerland, June 22nd, 1922.)
16,273. "Electric switching apparatus." Relay Automatic Telephone Co., Ltd., and F. M. Ward. June 22nd.
16,285. "Electric discharge devices." C. H. F. Müller (firm of). June 22nd. (Germany, June 23rd, 1922.)
16,289. "Electric switching means for water-heating apparatus, &c." E. H. Still and W. M. Still & Sons, Ltd. June 22nd.
16,290. "Electrical cooking appliances." H. H. Berry and C. A. Painton. June 22nd.
16,292. "Safety devices for power-driven clothes wringers, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). June 22nd.
16,293. "Enclosed furnaces." British Thomson-Houston Co., Ltd. (General Electric Co.). June 22nd.
16,300. "Wireless transmission and reception." T. Watson. June 22nd.
16,314. "Plug in electric coils." C. B. Kersting. June 22nd.
16,315. "Galvanic batteries." L. Fuller and Fuller's United Electric Works, Ltd. June 22nd.
16,336. "Wireless aerial." R. S. Collis and A. U. B. Ryall. June 23rd.
16,338. "Regulator for electric, steam, &c., radiators, &c." R. MacLaren. June 23rd.
16,341. "Elevator progress indicator." J. Crawford and D. B Gebbie. June 23rd.
16,361. "Crystal detector." F. L. Lash. June 23rd.
16,362. "Electric switches." J. Backus. June 23rd
16,363. "Means for obtaining intermittent unidirectional currents of electricity from alternating currents." A. Barnett. June 23rd.
16,364. "Electric motor-control systems." British Thomson-Houston Co., Ltd. (General Electric Co.). June 23rd.
16,365. "Variable condensers, &c." Burndept, Ltd., and C. F. Phillips. June 23rd.
16,367. "Thermionic valves, &c." E. S. Brown, G. E. Stubbs, and F. Warner. June 23rd.
16,372. "Electric welding." E. C. R. Marks (Pabst Co.). June 23rd.
16,374. "Impedance bonds for railway signalling systems." Automatic Telephone Manufacturing Co., Ltd., E. A. E. Hudd and P. N. Roseby. June 23.
16,379. "Receivers for wireless telegraphy." H. J. W. Barnes, H. L. Rayner, and L. B. Tickle. June 23rd.
16,382. "Wireless apparatus." W. R. Clark and J. H. Hutcheon. June 25th.
16,388. "Thermionic valves." F. R. Hickson. June 25th.
16,396. "Tramway rails." A. F. Louis. June 25th.
16,403. "Electromagnetic wave signalling systems." E. Boselli. June 25th.
16,406. "Method of protecting live rail for electric traction." C. R. Metcalf and N. Sefton. June 25th.
16,408. "Self-oiling wheel for tramcar trollies, &c." A. R. Heppenstall and J. H. Heppenstall. June 25th.
16,409. "Variable grid leak for wireless telegraphy, &c." J. L. Cartwright. June 25th.
16,410. "Trollies for electric tramways." W. Lawrance. June 25th.
16,420. "Contact wire crystal detector arm." L. Benson. June 25th.
16,421. "Plastic compositions for electric insulating and acid-proof materials." R. H. Abrey. June 25th.
16,427. "Lighting." A. Nicholson. June 25th.
16,433. "Ignition in internal-combustion engines." M. L. Bevington. June 25th.
16,434. "Automobile tail light control and indicators." H. A. Gill (Munro). June 25th.
16,442. "Distributing telephone or telegraph signals." G. W. Hale and R. Lyle. June 25th.
16,450. "Valve-holder adaptor." W. E. H. Humphreys. June 25th.
16,452. "Electric switches." C. H. Hopwood. June 25th.
16,466. "Telephones." F. P. Bergmann. June 25th.
16,475. "Amplification of electric currents." British Thomson-Houston Co., Ltd. June 25th. (United States, June 26th, 1922.)
16,476. "Amplifiers." British Thomson-Houston Co., Ltd. June 25th. (United States, June 26th, 1922.)
16,480. "Devices for converting pressure effects into equivalent electrical effects." A. Frisch. June 25th. (Germany, June 29th, 1922.)
16,483. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 25th. (United States, July 15th, 1922.)
16,489. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. June 25th. (United States, August 17th, 1922.)
16,490. "Electric contactor devices." G. Page and A. West & Co., Ltd. June 25th.
16,568. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). June 26th.
16,574. "Illuminated electric signs." H. G. Detheridge. June 26th.
16,575. "Crystal receiver set for wireless signalling." L. L. R. Dean. June 26th.
16,583. "Controlling electric current by sounds." L. de Forest. June 26th. (United States, October 28th, 1922.)
16,592. "Party-line telephones." G. H. Bryant, B. B. Johnson, Relay Automatic Telephone Co., Ltd., and R. G. Vanneck. June 26th.
16,597. "Rectifiers." C. E. Ogden. June 26th. (United States, December 26th, 1922.)
16,598. "Vibrators for alternating-current rectifiers." C. E. Ogden. June 26th. (United States, October 2nd, 1922.)
16,610. "Alternating-current commutator machine." N. Japolsky and M. Kostenko. June 26th.
16,615. "Variable condensers." A. B. Cole, Inc. June 26th. (United States, August 1st, 1922.)
16,621. "Apparatus for converting electricity into heat." J. H. Rowlands and G. Thomas. June 26th.
16,622. "Apparatus for converting electricity into heat." J. H. Rowlands and G. Thomas. June 26th.
16,623. "Apparatus for converting electricity into heat. J. H. Rowlands and G. Thomas. June 26th.
16,624. "Apparatus for converting electricity into heat." J. H. Rowlands and G. Thomas. June 26th.
16,642. "Manufacture of knobs, terminals, &c." A. Round. June 27th.
16,644. "Cover for electric light switches." W. Simpkin. June 27th.

16,656. "Dual amplification in wireless reception." E. T. Bateman and F. E. Sinclair. June 27th.
16,658. "Earthing clips." J. S. Swainson. June 27th.
16,674. "Electric tube-welding machines." E. Schröder. June 27th.
16,675. "Receiving apparatus for wireless telegraphy, &c." W. McClure. June 27th.
16,677. "Seals for leading-in conductors of electric apparatus." Metropolitan-Vickers Electrical Co., Ltd., and E. Y. Robinson. June 27th.
16,678. "Controllers for electric traction, &c." R. Brooks, W. T. Gray and Metropolitan-Vickers Electrical Co., Ltd. June 27th.
16,679. "Hand- or mechanically-driven electric generators." E. Wythe-Smith. June 27th.
16,680. "Galvanic batteries." L. Fuller and Fuller's United Electric Works, Ltd. June 27th.
16,683. "Loud speaker for wireless apparatus." H. W. Parker. June 27th.
16,689. "Apparatus for simultaneous reception and re-transmission of radio-telegraph, &c., signals." A. W. Sharman. June 27th.
16,692. "Ignition-control switches on internal-combustion engines." Thomas Inventions Development Co., Ltd., and J. G. P. Thomas. June 27th.
16,702. "Insulating material." H. G. Clark and H. T. Culliford. June 27th.
16,703. "Condensers and inductance coils for tuned electric circuits." C. F. Elwell, Ltd., and B. E. G. Mittell. June 27th.
16,708. "Electric switches." G. Marr. June 27th.
16,716. "Electric conductors." Siemens & Halske Akt. Ges. June 27th (Germany, July 3rd, 1922.)
16,718. "Device for arresting mine cages, &c., on breakage of winding cable." E. N. Weighell. June 27th.
16,732. "Wireless receiving circuits." N. P. Hinton and Metropolitan-Vickers Electrical Co., Ltd. June 27th.
16,733. "Wireless receiving circuits." N. P. Hinton and Metropolitan-Vickers Electrical Co., Ltd. June 27th.
16,737. "Radio transmitting systems." T. L. Eckersley. June 27th.
16,739. "Diaphragms for telephones, gramophones, &c." A. T. Collier. June 27th.
16,743. "Electric lighting for vehicles." L. J. C. Tolmer. June 27th. (France, June 28th, 1922.)
16,744. "Rheostats." P. W. Baker. June 27th.
16,750. "Electric irons." K. M. Raymond. June 27th.
16,756. "Wireless telegraphy, &c." Radio Communication Co., Ltd., and J. Scott-Taggart. June 27th.
16,757. "Means of mounting and insulating valve legs of wireless receiving sets, &c." A. E. Bowyer-Lowe. June 27th.
16,758. "Variable resistances for valves for wireless receiving sets, &c." A. E. Bowyer-Lowe. June 27th.
16,762. "Electric power transmission." A. M. Taylor. June 28th.
16,765. "Wireless receiving sets." J. C. Trickey. June 28th.
16,772. "Electric control arrangements." J. R. C. August and E. K. Hunter. June 28th.
16,814. "Reception of wireless telegraphy, &c." L. S. Langley. June 28th.
16,820. "Electric resistances." A. H. S. McCallum. June 28th.
16,821. "Wire-drawing apparatus." Western Electric Co., Ltd. (Western Electric Co., Inc.). June 28th.
16,842. "Wireless communication." H. J. Harvey. June 28th.
16,844. "Electric power systems." C. Meyer. June 28th.
16,846. "Receiving apparatus for telegraphy, &c." Siemens & Halske Akt. Ges. June 28th. (Germany, January 23rd.)
16,851. "Crystal detector." T. Hutchings. June 28th.
16,852. "Wireless receiving circuits." H. G. Bell, W. J. Brown, and Metropolitan-Vickers Electrical Co., Ltd. June 28th.
16,853. "Control systems for motors of electric tramcars, &c." Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. June 28th.
16,854. "Electric inductance coils for high-frequency circuits." N. P. Hinton and Metropolitan-Vickers Electrical Co., Ltd. June 28th.
16,860. "Electrodes for electric arcs." D. Gardner, H. L. R. Lunden, and C. G. T. Salenius. June 28th.
16,863. "Electric resistances." J. L. Capelle. June 29th.
16,869. "Electric motor-control systems." British Thomson-Houston Co., Ltd. (Compagnie Française Thomson-Houston). June 28th.
16,874. "Electromagnetic means for transmitting and reproducing sound." A. F. Sykes. June 28th.
16,876. "Detector for wireless receiving sets." A. M. Hooper. June 29th.
16,877. "Earthing running rails, &c." J. McCreath. June 29th.
16,880. "Wireless loud-speaker attachment for gramophones." F. Thody. June 29th.
16,901. "Illuminated signs." E. W. Chamberlain. June 29th.
16,905. "Pneumatically-controlled condenser for wireless telegraphy." C. Dell. June 29th.
16,916. "Insulators for aerial or line wires." T. A. E. Haywood and T. E. Haywood. June 29th.
16,932. "Telephone receiver." Anciens Etablissements E. Picard Soc. Anon. June 29th. (France, July 6th, 1922.)
16,936. "Telephone instruments." S. S. Petticord. June 29th.
16,940. "Loaded telephone circuits." A. C. Bartlett and General Electric Co., Ltd. June 29th.
16,941. "Means for illuminating by diffused reflected light." A. A. D. Lang and A. D. Lang, Ltd. June 29th.
16,944. "Variable electric condenser." W. A. Chambers and R. M. Ellis. June 29th.
16,945. "Alternating-current electricity meters." Ferranti, Ltd., and S. Z. de Ferranti. June 29th.
16,948. "Devices for electric distant control of signals." V. Planer. June 29th. (Germany, December 28th, 1922.)
16,950. "Arc lamp carbons and electrodes." A. Borchers and P. Schiff and Co. June 29th. (Austria, July 27th, 1922.)
16,953. "Apparatus for reproduction of sounds." G. Seibt. June 29th.
16,954. "Oscillating bodies for sound reproduction." G. Seibt. June 29th.
16,964. "Automatic electric switch." C. French. June 29th.
16,969. "Electric power transmission." A. M. Taylor. June 30th.
16,988. "Mounting tubular pole arms upon telephone poles, &c." G. A. T. Legg and E. Lewis & Sons, Ltd. June 30th.
16,989. "Means for locking electric lamp bulbs." G. W. Short and C. W. Woods. June 30th.
17,005. "Telephones." H. M. McNaughton-Jones. June 30th.
17,009. "Systems of generation of alternating current." E. Y. Robinson. June 30th.
17,027. "Motor-vehicle, &c., lamps." J. P. Haworth. June 30th.
17,034. "Pendant for lighting apparatus, &c." R. Baron. June 30th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

10,403. "Lamps, searchlights, and the like." J. G. Smith. February 8th, 1922. (199,049.)
32,844. "Sound receiver, particularly for receiving sound waves in liquids." Signal Ges. December 7th, 1920. (172,637.)

1922.

1,167. "Synchronous electric distant control apparatus." E. Grass. January 14th, 1921. (174,082.)
3,698. "Gas-filled electric discharge tubes with independent discharge." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. February 9th, 1921. (175,275.)
4,219. "Protective systems for alternating-current circuits." A. E. McCall, C. C. Garrard, W. Wilson and A. H. Railing. February 13th, 1922. (199,068.)
4,488. "Electric accumulators." O. Neumann and A. Neumann. January 5th, 1922. (191,358.)
4,718. "Control of electrically-propelled vehicles." English Electric Co., Ltd., and C. F. Barnholdt. February 17th, 1922. (199,074.)
6,536. "Telephone instrument apparatus and attachments." H. D. Fyns. March 6th, 1922. (199,076.)
6,955. "Electric lamp fittings." R. M. Beard. March 9th, 1922. (199,088.)
7,106. "Current-collecting apparatus for electricity." C. W. Kay. January 9th, 1923. (199,068.)
7,345. "Printing telegraph receiver." Western Electric Co., Ltd. (Western Electric Co., Inc.). March 13th, 1922. (199,101.)
7,358. "Electrically-heated fabrics." A. Negromanti. March 13th, 1922. (Addition to 173,205.) (199,106.)
7,369. "Method of and apparatus for producing commutator bars." S. J. Watson and A. O. Hinchliff. March 13th, 1922. (199,109.)
7,371. "Infusible electrothermic safety devices." R. Lenner, P. Parvopassu, and G. Gallo. March 13th, 1922. (199,110.)
7,437. "Devices for attachment to the mouthpieces of telephone transmitters and other sound-transmitting instruments." Plantation Rubber Manufacturing Co., Ltd., and M. M. Dessau. March 14th, 1922. (199,115.)
7,472. "Electrical insulating cylinders." A. P. M. Fleming, B. S. and W. Whiteley, Ltd., and Metropolitan-Vickers Electrical Co., Ltd. March 14th, 1922. (199,118.)
7,494. "Thermionic valve amplifiers." J. M. Miller. March 15th, 1922. (177,161.)
7,548. "Construction of accumulator and accessory carrying cases for motor vehicles and the like." R. H. Playfoot. March 15th, 1922. (199,124.)
7,734. "Electromagnetic relay." D. C. Crowe. March 16th, 1922. (199,135.)
7,771. "Electrical switch point detecting and like apparatus." British Power Railway Signal Co., Ltd., and J. Ashton. March 16th, 1922. (199,141.)
7,775. "Electric cut-outs." A. Baderna. March 17th, 1921. (177,179.)
7,987. "Apparatus for controlling railway signals of the electric light type, whereby the 'danger' indication is extinguished when the 'clear' indication is illuminated without breaking the circuit to the lamp giving the 'danger' indication. R. Dell. March 18th, 1922. (199,150.)
8,502. "Electric switches." C. L. Pratt and L. J. Hooper. March 23rd, 1922. (199,165.)
10,649. "Cooling of electrical apparatus." Bureau d'Organisation Economique. April 13th, 1921. (178,402.)
10,704. "Radio-transmitting systems." British Thomson-Houston Co., Ltd., and E. F. W. Alexanderson. April 13th, 1922. (Addition to 178,402.) (199,192.)
11,127. "Protective devices for dynamo-electric machines." English Electric Co., Ltd., and W. E. M. Ayres. April 20th, 1922. (199,201.)
12,735. "Electric hand-laundry irons of domestic and laundry type." R. Warbrick and Callender's Cable and Construction Co., Ltd. May 5th, 1922. (199,212.)
12,793. "Electrical energy supply systems." J. W. Cox. May 6th, 1922. (199,214.)
12,868. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. May 18th, 1921. (180,317.)
14,494. "Wave-length and the like indicators for use in wireless telegraphy and wireless telephony." H. P. Rees. May 23rd, 1922. (199,233.)
14,597. "Saxophones." Hawkes & Sons (G. Swerts). May 24th, 1922. (199,237.)
14,625. "Construction of electric condensers of continuously variable capacity." A. C. Huskinson. May 24th, 1922. (199,238.)
15,884. "Electric resistances." F. Pellin and G. Pelletier. June 8th, 1921. (Addition to 165,099.) (181,368.)
16,671. "High-tension magneto-electric machines." W. T. Turner. June 16th, 1922. (199,251.)
17,026. "Electrical transformers." A. G. Ellis and Metropolitan-Vickers Electrical Co., Ltd. June 20th, 1922. (199,255.)
17,195. "Inductance coils for use in wireless telegraphy, telephony, and the like." J. H. L. Bridge. June 22nd, 1922. (199,258.)
19,125. "Ignition systems for internal-combustion motors." M. Mallet. July 12th, 1922. (199,271.)
19,344. "Electric furnaces." F. I. A. T. Soc. Anon. December 23rd, 1921. (190,695.)
20,870. "Wireless systems and apparatus." J. Robinson. July 31st, 1922. (199,279.)
21,251. "Electrical capacitance control devices." Igranic Electric Co. Ltd. (Cutler-Hammer Manufacturing Co.). August 3rd, 1922. (199,283.)
21,670. "Power shut-off mechanism for electric motors." J. T. Pedersen. August 9th, 1922. (199,284.)
21,819. "Electric arc-welding apparatus." British Thomson-Houston Co. Ltd. September 23rd, 1921. (186,314.)
22,820. "Multiple fuse plugs." O. F. Foss. August 22nd, 1922. (199,300.)
24,597. "Electric controlling devices." Sullivan Machinery Co. November 25th, 1921. (189,424.)
26,843. "Galvanic cells and batteries." R. Pörscke and F. Fischer. October 4th, 1922. (199,308.)
26,844. "Galvanic cells and batteries." R. Pörscke and F. Fischer. October 4th, 1922. (199,309.)
26,868. "Carbon holder for arc lamps having rotary carbons." Anciens Etablissements Barbier, Benard, et Turenne Soc. Anon. August 23rd, 1922. (199,310.)
28,190. "Electrical interrupters." A. B. Palés. June 13th, 1922. (199,317.)
31,833. "Telephone instruments." Automatic Telephone Manufacturing Co., Ltd. April 10th, 1922. (195,929.)
32,114. "Ignition apparatus for internal-combustion pumps." S. Christie. March 6th, 1922. (Divided application on 198,754.) (Cognate application 8,952/22.) (199,325.)
33,069. "Automatic telephone systems." T. Lenaghan. January 9th, 1922. (Divided application on 1,360/22.) (199,327.)
35,343. "Apparatus for collecting current from overhead conductors for electric traction." O. Kurz. March 7th, 1921. (Divided application on 176,769.) (191,068.)

1923.

6,766. "Prevention of overheating of laundry irons and other electrically heated appliances." C. A. Simpson. April 1st, 1922. (195,605.)
8,998. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 27th, 1922. (Divided application on 198,413.) (199,413.)
9,534. "Electric switches." Hart Manufacturing Co. February 24th, 1922. (Divided application on 175,972.) (195,981.)